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The mechanical conventions at Atlantic City that ended yesterday were eminently successful. The attendance of members was 10 per cent larger than in any past year. The space occupied by exhibits was 7 per cent greater than ever before, and exceeded the space occupied at the Jamestown Exposition. The discussions were suggestive, instructive, fruitful; it might seem unfair discrimination to name specific cases where there was so much said and done that was important. The weather, while warm, was fair and was never so hot as to interfere with business or pleasure. The social and entertainment features were well planned, well managed and much enjoyed. The officers and committees of the various associations, who are no doubt all glad that their hard work in this connection is done for this year, deserve to be congratulated on the results.

In the discussion on Tuesday on "The Apprenticeship System," one or two points were brought out which do not appear to have been particularly noticed before. Mr. Vauclain, in enumerating the qualifications of the three classes of apprentices of which the Baldwin Locomotive Works makes use, stated that their best men, while having some technical education, were not necessarily graduates of a technical school. He stated that his firm is very favorably inclined toward boys who enter the technical school and because of being conditioned in one or more studies are discouraged over the prospect of completing the course within the allotted time and so leave school. The point was made that this class of men usually develop a greater capacity for handling their fellow men than those whose scholarship is such as to enable them to maintain a high standing in all branches of the course. This conclusion is of course in harmony with what has repeatedly been observed in relation to the results of non-technical schools and is of a nature to relieve some of the anxiety that may be felt with reference to a boy who seems unable to complete the prescribed curriculum of the schools. There is another point which Mr. Vauclain did not mention and which is probably of considerable importance in connection with apprenticeship work and the capacity of the trained apprentice to become especially valuable to his employer subsequently. The very fact that the young man meets with but indifferent success in some branches of his work, though standing well in others, is the indication in many cases of admirable material upon which to graft the training of the specialist—and most apprenticeship-trained men become specialists sooner or later. Another point to which reference was made was as to the cost of training apprentices. The primary object of an apprenticeship system is to train men to be valuable employes of the company—an advantage to it. Certainly in seeking to attain this end there should be no attempt to make money out of the course of instruction. One member of the association said that the railroads ought to be prepared to put something into the soil before expecting to harvest a crop. The process in human training as in farming is ruinously exhaustive of the natural resources it originally possessed.

It is of interest as marking the progress resulting from the railroad mechanical conventions that in one of the topical discussions had on Wednesday the use of any other than a metallic joint for the connection between engine and tender was strongly disapproved. It is only within a few years that universal metallic joint connections for this purpose were seriously considered as a possibility. Though the discussion was not carried to any great length the views that were expressed were entirely in favor of the metal joint. The line of further progress was clearly suggested by one of the members who expressed the opinion that the time had gone by when any less stable and permanent connection should be used for this purpose or between cars.

Mr. Squires' paper on "Fuel Economy" and Mr. Bentley's remarks on "Smoke Prevention" before the Master Mechanics' Association on Monday emphasize the importance of the brick arch as a most efficient spark arrester and smoke preventer. While the Master Mechanics recognize this fact, there are many roads which have almost abandoned the brick arch, on account of the frequent renewals required, and the consequent high cost of maintenance. Much of this is due to carelessness in applying the arch and to rough usage, generally by enginehouse men. If this is true of the plain brick arch it would be expected that with a hollow or compound arch these conditions would be further exaggerated and their use made almost prohibitive. It has been demonstrated, however, by a company interested in the hollow brick arch that by exercising proper care in applying the arch and with special supervision of its repairs the expense for the continuous use of brick arches need not be burdensome. The same company is so fully assured of its ability to maintain brick arches at moderate cost that it has made contracts with some roads to put the arches in locomotives under its own direction and maintain them at a less cost than is required for the plain arch.

The great change that is gradually taking place in the manner of viewing discussions in which labor questions may possibly be involved is strikingly shown, by a comparison of the attitude of the Master Mechanics' Association this year with its position three or four years ago. It is remembered distinctly that a damper was placed upon a member who at that time made some reference to the attitude of organized labor toward the subject under discussion, and though the discussion was continued for the greater part of an hour, it was with the understanding that the whole matter should

be omitted from the proceedings. This year, fortunately, the association has a president who not only has some very lucid ideas upon the relations which should exist between railroad companies and their employes, but also has the courage of his convictions. A thoughtful reading of the president's address as published elsewhere in this issue would be beneficial to anyone interested in either side of this hitherto troublesome matter.

The Master Car Builders' Association is a legislative body and its prestige is in great measure due to this fact. And since legislative bodies are essentially unwieldly unless they partake of the autocratic element, as does for instance, the national house of representatives which does business under the direction of the committee on rules, it is important that every effort should be made to secure efficiency in the despatch of business. This year there was discussion of but few reports and it was of a character that would have been better submitted in committee instead of on the floor of the convention. Also, there was manifested a disposition to invoke needlessly the referendum principle by ordering letter ballots taken on questions which the association in convention was authorized to decide.

BRIQUETS FOR LOCOMOTIVE FUEL.

The tests of briquets, conducted by the Pennsylvania Railroad at the locomotive testing plant at Altoona, were made for the purpose of ascertaining whether those made from a friable coal would materially reduce the loss because of sparks and improve conditions in regard to the smoke nuisance. The results of the test as reported in Mr. Gibbs' paper show comparatively little difference between the two forms of fuel in the quantity of cinders collected in the smoke box. As no figures are given for the amount of fuel lost in sparks discharged through the stack, this portion of the investigation is not conclusive. The effect of briquetting on reducing the amount of smoke is more pronounced, and although the raw coal is classed as semi-smokeless, and the average smoke from it ranked as two on the scale in which five signifies black smoke. The briquets averaged only one-half as much smoke as the raw coal for the different speeds.

Although the cost of briquetting this coal is not given, it is fair to conclude from data obtained elsewhere that the economy as shown by the higher rate of evaporation and the lower consumption of fuel attending the use of the briquets, would not be sufficient to offset the extra cost of briquetting, and in the present state of the art some sacrifice in extra expense for fuel would have to be made in order to obtain the advantage of the smokeless coal. For evaporative results the average condition is best represented by the rate 12 pounds per square foot of heating surface per hour, and at this rate the equivalent evaporation per pound of fuel was 8 pounds of water for the raw coal and 9.7 pounds for the briquets. This shows an economy of 20 per cent in favor of the briquets. The fuel consumption per horsepower was given as 4.48 pounds per horsepower-hour for raw coal and 3.65 pounds for round briquets, or a saving of 18½ per cent in fuel due to the briquetting.

The cost of briquetting coal at the government plant at St. Louis was about as follows: With gashouse pitch costing $9.00 per ton and an average mixture of five or six per cent the cost of the binder per ton of product was 45 to 55 cents. The labor cost was nearly $1.00 per ton, and interest and depreciation 50 cents per ton on a plant producing 75 tons per day, making a total of $2.00 per ton in addition to the cost of the raw coal. Even if conditions can be so improved so that the cost of briquets is reduced to one-half this amount or $1.00 per ton, there are few places in the eastern states where briquets can be used with economical results. With a saving of 20 per cent the price of lump coal would have to be $5.00 per ton to warrant briquetting. With coal averaging $2.00 per ton and briquetting costing $1.00 per ton, there would be required a saving in evaporation of 50 per cent over that of the raw coal, which it is not possible to obtain. However, if the briquetting will permit the use of a fuel that otherwise would not be available the question of cost assumes a different aspect, and comparison as to costs is between the cheapest available fuel and the briquets.

The first railroad in the United States to go into the manufacture of coal briquets for locomotive fuel was the Chicago Rock Island & Pacific. In 1906 the Rock Island sent to the fuel experiment station at St. Louis samples of coal from Oklahoma which were converted into briquets, and tested on the Illinois division of that road. A number of cars of briquets of various sizes and shapes were burned on the locomotives in all branches of the service with satisfactory results. The main purposes of these tests were to determine the adaptability of briquets as a locomotive fuel and the comparative cost with relation to raw coal and to find the effect in the prevention of smoke. Two sizes of briquets were used; one was of brick shape 7 by 4½ by 3 inches, weighing four pounds, and the other was cylindrical with convex ends, weighing one pound. A gas pitch was used as a binder in proportions ranging from four to eight per cent.

These tests showed that the relative value of briquets compared with lump coal coming from the same mine was as follows: One pound of lump coal evaporated 8.45 pounds of water, while the briquets evaporated on an average 9.5 pounds of water, showing an increase in efficiency of 12½ per cent. This increased evaporation from the same coal is explained by the fact that when raw coal comes in contact with a hot fire it begins to crack and check and a large proportion of volatile gases passes off as smoke, not having an opportunity to come in contact with sufficient quantities of oxygen at the proper temperature. In burning briquets the process is quite different; the mass of finely pulverized particles is held together by the binder and densely compressed, and there is little checking caused by the high temperature. The consumption of the fuel is at an even and economical rate, and this accounts for the smaller quantity used as well as the elimination of smoke.

As a result of this satisfactory use of briquets on locomotives, the Rock Island purchased the briquet machine which was used by the government at the Jamestown Exposition and it is now installed at the briquet plant at Hartshorne, Okla. In the manufacture of briquets at this place the coal is first screened, the small lumps which pass over a ½-inch square mesh being loaded into cars and sold as pea coal. The fine coal which passes through the ½-inch square mesh is stored in a bin having a capacity of 200 tons. From this bin the coal is conveyed to a feed box at the rate required by the press and the pitch binder empties into this box in proper proportion. The mixture of coal and pitch then passes through a Williams crusher which further mixes and pulverizes the coal. It then passes through a heater consisting of a screw conveyor, operating in steam-jacketed pipes filled with superheated steam at 400 degrees F. temperature. These heaters are 50 feet long and by the time the coal reaches the briquet machine a large amount of moisture has been removed from the coal and it is thoroughly heated. After passing through the press the briquets drop onto a belt conveyor which serves as a cooling table and they are then ready for loading.

The plant has a capacity of eight tons per hour and about 130,000 briquets are made per day. A pressure of 4,000 pounds is given each briquet in the press and the machinery is operated by a 100-horsepower steam plant. The briquetting method for the present is confined to such coals and localities where the selling price of slack is at least $1.00 per ton below the price of lump coal at the mines.

THE MACHINE TOOL EXHIBIT.

The machine tool exhibit this year is an improvement over that of last year not only in the number of tools exhibited but in the effective setting. This results from grouping all the tools in one well-lighted pavilion, giving the impression of a completely equipped and well-arranged machine shop in full working order, and including representatives of most of the standard tools. Many of the tools are directly driven by self-contained electric motors, and in this respect it is instructive to see that this method of drive can be easily applied to nearly all classes of tools with little change in the general design or in an improvement of the design. A good example of well worked out design for direct motor drive is the Lodge & Shipley 24 by 12-inch patent head standard screw cutting engine lathe. This uses a 10-horsepower motor having a variation of speed from 450 to 900 revolutions, and six mechanical speed changes in the head stock. The lathe has also electrical speed changes through the controller for each mechanical change and electrical speed control at the apron. Thirty-two feed changes and the same number of threading changes can be made while the lathe is running. The same company exhibits a neat design for 16-inch portable lathe mounted on wheels so that the lathe can be wheeled about on the floor and it thus becomes a great convenience for use in roundhouses. It is specially adapted for bolt work and as only necessary devices have been retained the lathe is simple and can be bought at a low cost.

The Springfield Machine Tool Company exhibits a 19-inch high power rapid reduction lathe with power transmitted by a silent chain drive instead of a train of gears, and in this way the heavy and cumbersome construction of gear drive is avoided. The lathe is driven by a 7½-horsepower motor which operates between 500 and 1,000 revolutions and with a constant speed motor eight mechanical speeds are obtained. The control of the motor is made very convenient by an operating lever at the righthand side of the apron which is out of the way of the operator. Under severe tests this lathe has proved to be remarkably steady under the heaviest cuts and the chattering and jerking motion often found in high speed lathes is avoided. With the speeds and feeds possible together with high power this lathe is representative of a high type of design and accurate and careful manufacture.

Lodge & Shipley show a lathe with an attachment particularly adapted to users of twist drills, shaft couplings, eccentrics, etc. It is made especially for turning and boring odd shapes. For this purpose the eccentric discs are mounted upon a long lower slide that moves directly from the bridge of the lathe carriage and extends down over the taper attachment and is bolted to the shoe of sliding block of the taper dove-tail, consequently taper ovals, squares, eccentrics, etc., may be bored and turned. By easy adjustment it is possible to obtain any throw from zero to a combined throw of both eccentrics. This maximum throw is ½ inch for eccentrics and one inch for ovals, squares and cams.

There are several fine examples of large turret lathes, the Gisholt Machine Company exhibiting a 24-inch boring lathe with a 6¼-inch hole through the spindle. This machine was designed to meet the change in sentiment in the past few years which has been toward the manufacture of odd turned shapes directly from bars. It will handle stock up to 6 inches in diameter with sufficient strength to care easily for the largest bar work in its range. The machine has a large chuck on the face plate and it can be used for boring the holes in piston rods, back cylinder heads, etc.

Bardons & Oliver, Cleveland, O., exhibit a large automatic chuck turret lathe, capacity 4½ inches by 30 inches, with a geared head driven by a constant speed motor of 15 horsepower. This machine is well adapted for making locomotive wrist pins, knuckle pins, brake-hanger pins and large bushings. In this machine all the collet parts are self-contained within the spindle and thus the overhang is reduced to a minimum. This is one of the most important features of this bar machine. The opening and closing of the automatic chuck as well as the feed of the bar is accomplished without stopping the machine, thus saving a great deal of time. There is a heavy guide bolted directly to the rear end of the head extending far enough back to reach the end of a 20-foot bar when placed in the machine. For holding bars from 4½ to 5 inches a special heavy three-jawed universal chuck is used and the automatic chuck plunger and collet are removed, thus giving a 5-inch hole through the spindle and chuck. The same company exhibits a small turret lathe for handling a variety of brass work. It has a back collet holding a variety of castings and is furnished with an automatic indexing turret and vertical forming slide.

The exhibit of milling machines includes a number which have been redesigned and made extra powerful for use with direct-driven motors. The Cincinnati Milling Machine Company exhibits a vertical high power miller which is capable of removing 10 cubic inches of steel per minute. This machine is direct-connected to a 10-horsepower motor, and is shown in operation when taking a roughing cut on .20 carbon steel bars. In doing this 12 horsepower is consumed and when corrected for motor efficiency the net horsepower is ten, thus equaling one cubic inch of steel removed per net horsepower minute.

The Lucas Machine Tool Company, Cleveland, O., exhibits a large and finely finished special tool which can be used for boring, drilling or milling. The spindle is four inches in diameter, the total traverse 60 inches and the greatest distance between face plate and outer support for boring bar six feet. The size of the platen is 30 by 48 inches. The machine is intended to be universal and capable of finishing at one setting many kinds of pieces which otherwise would require resetting or finishing in other machines. The addition of a graduated revolving table allows holes to be bored and drilled and surfaces to be milled at various angles. The same company exhibits a neat design of power forcing press with a capacity of 50 tons.

The three milling machines exhibited by Brown & Sharpe Company represent new ideas in the design of milling machines in the use of constant speed drive. This method was originated by Brown & Sharpe. The fundamental principle of this type of machine is a single pulley or motor running at constant speed from which develop features which are of distinct advantage in modern milling machine practice. The difficulties due to a variation of power when changing from one speed to another have been overcome by a series of gears enclosed in the spindle head. It is possible to arrange the speeds required for various diameters of cutters within the capacity of the machine. This condition was made necessary by the use of high speed steel, especially in large machines. The No. 5 B heavy plain milling or slabbing machine made by this company is well adapted to finishing locomotive rods, boxes, gibs, etc., and will remove cast iron at the rate of 30 cubic inches per minute. This machine has a vertical spindle attachment which is exhibited separately.

There are two planers on exhibition, one, a 37-inch variable speed heavy forge planer exhibited by the Cincinnati Planer Company. This is a new design built to take care of the heavier class of work and has four changes of cutting speeds from 20 up to 45 feet per minute. The return speed remains constant. The planer is driven by a 15-horsepower constant speed motor. This machine illustrates the importance of convenient change of cutting speed adapting it to different materials and conditions. The new drive on this planer makes it possible to use a cut at a speed of 40 feet per minute and return at 80 feet, making 1,600 cutting feet per hour, while the ordinary planer operating at a speed of 20 feet cut and 80 feet return makes only 960 cutting feet per hour, the improved Cincinnati planer showing a gain of nearly 70 per cent in actual cutting speed.

The only shaper exhibited is in connection with the General Electric Company's exhibit and is that of Gould & Eberhardt. This has a 24-inch stroke and uses a 5-horsepower motor. It is specially notable for the convenient arrangement of the feed handles.

Only three drill presses are exhibited, one a radial drill and the other the heavy new pattern sliding head drill manufactured by the Cincinnati Machine Tool Company. This latter machine is fitted with patent geared tapping attachments, friction back gears, positive geared feed and variable speed motor drive for high speed drills. The friction back gears can be changed while the machine is running and 19 changes of speed are obtained through the controller. These are doubled by means of back gearing. This machine is built especially for use with high speed steel twist drills.

The Bickford full universal radial drill presents a number of new features in its design and is claimed to be the only radial drill press on the market that possesses the same power and stiffness as a plain machine. The radial arm has a double pipe section with the guides spread apart to give ample room for the gearing. The back gear is in the head and there are few gear wheels required for the motor drive. The drill press exhibited has a capacity up to No. 5 pipe tap. The tapping mechanism is located on the head and permits the backing out of taps at any speed regardless of the speed used in driving them. The speed box furnishes 8 changes of speed, which taken in connection with the back gears on the head gives the operator a choice of 24 speeds, each of which is instantly available.

Baker Brothers, Toledo, exhibit a heavy drill press especially adapted to high speed drill, with a capacity up to 1½-inch stock at maximum speed and feed. This machine has a record of drilling 2-inch holes in cast iron at a speed of 350 revolutions and a feed of 26 inches per minute, and a rate of 8 inches per minute in forged steel.

The one slotting machine exhibited is the 15-inch Dill slotter manufactured by the T. C. Dill Machine Company, Philadelphia. This is driven by a 5-horsepower motor and is claimed to have a greater range than the ordinary slotting machine. The special features include a traveling head which secures this increased range, a quick traverse gear, which is a great saver of time and labor, a new quick return which permits high and uniform cutting speeds, a tool post in the relief apron convenient in changing tools, and six changes of speed. This is more than are found in the ordinary slotting machine.

The Gisholt Machine Company exhibits a 52-inch vertical boring mill, an important addition to its line of tools. This machine has been especially designed for the severe duty accompanying the use of high speed steel. It is equipped with labor and time saving devices which give it a maximum output with ease of operation. All the Gisholt mills are equipped with micrometer index and feed-trip devices which may be so set as positively and automatically to trip and stop in cutting at a predetermined point. They are also arranged for rapid traverse of the heads by power in all directions.

Grinding machines are well represented by a number of manufacturers, one of the most conspicuous machines being the 84-inch locomotive guide face-grinder manufactured by the Diamond Machine Company, Providence, R. I. This was designed especially for grinding case hardened locomotive guides, but it is also useful for a variety of ordinary shop work. Some of the advantages of finishing guides in this way are that the work does not require such rigid fastening to the platen as when it is done on the planer or milling machine. The movements are all rapid compared with those of other machines. The emery wheel is held in a steel bound adjustable chuck, as wheels on machines of this nature should not be run unsupported. This machine is of recent design. The same company exhibits a tool grinding machine with a large removable water guard which is especially adapted to long tools, and prevents water from being scattered around the machine on the floor. The Landis Tool Company, Waynesboro, Pa., exhibits its No. 3 Universal grinding machine with automatic heads. This machine has 12-inch swing and the length is 42 inches between centers. William Sellers & Co. exhibit two of their standard tool grinders and one twist drill grinder. These machines have proved to be very useful in sharpening the lathe planer tools and twist drills used on a number of the machines described above. A solid design for spiral disc grinder is exhibited by Charles H. Besley & Co., Chicago. It has two 20-inch spiral grooved steel discs and has the advantage of a shear cutting with emery without the danger of breaking the emery wheel.

Bolt and nut threading machinery is represented by a number of fine machines, some of them of new design, the Landis Machine Company exhibiting a 2-inch single motor driven bolt cutter with patent all-steel die head. The motor has a speed variation of 500 to 2,000 revolutions and if high speed dies are used the higher velocities become available. The variable speed motors are preferred on these machines, as they avoid all mechanical speed changes and secure all necessary speeds.

The Walter H. Foster Company of New York has a prominent exhibit in the 6-spindle vertical machine equipped with Lassiter staybolt threading and reducing heads. This machine can be operated at 75 revolutions per minute, producing 200 staybolts per minute at a cost of thirteen cents per hundred. On this basis the total cost for 1,500 staybolts required for the average boiler would only be $2 per boiler, as the total labor cost for threading and reducing staybolts. Another interesting machine made under the Lassiter patents is the straight or taper bolt turning machine especially adapted for locomotive construction. The output of this machine is very much in excess of that produced by other methods, as 1,000 1¼ by 9-inch taper bolts can be rough turned and finished in 10 hours and the accuracy of the finish is very much above that produced by those of ordinary lathe methods. The output of a good engine lathe in roughing and finishing taper bolts is not over 50 in 10 hours, and the average cost of roughing and finishing the bolts in the Lassiter machine is only about 50 cents per hundred. A new machine designed under Mr. Lassiter's directions is here first exhibited. This is intended for changing the shape of the heads of bolts so as to make them cylindrical taper or reduce the height of the head. Another new machine exhibited for the first time by the W. H. Foster Company is the Lassiter automatic nut reaming and tapping machine. There are two horizontal spindles which carry either reamers or taps, the tools at one end entering the nut while those at the opposite end are being withdrawn. There are two hoppers having an automatic device which properly arrange nuts in two run-ways or conveyances leading to the tools.

The National Acme Manufacturing Company also exhibits an automatic multiple-spindle screw machine. This is motor driven with a chuck capacity of 2¼ inches. In this machine four bars are operated upon at one time and one set of tools only is used, while eight or more operations may be readily performed at the same time. It is capable of producing duplicate mill parts in large quantities and at low cost. The Stoever Foundry & Manufacturing Company of Lebanon, Pa., exhibits its Stoever motor driven pipe machine. A constant speed motor is placed above the main bearings of the machine and connected by silent chain to the main driving gear. The changes of speed for the spindle are made as in the belt driven type.

Taken as a whole the machine tool exhibit is a remarkable exposition of the rapid progress which has been made in adapting tools to the severe requirements of alloy steels, and in the application of direct connected motors which provide the high speed necessary for maximum efficiency in the use of such steels without pulleys, countershafts and belts, and with very few gears.

MASTER MECHANICS' ASSOCIATION.

Proceedings of the Third Session of the Forty-first Annual Convention.

President McIntosh called the meeting to order at 9.40 o'clock.

The secretary read a letter from Charles B. Dudley, president of the American Society for Testing Materials, expressing appreciation of the invitation to visit the exhibits on the convention pier and expressing the hope that as many as possible of the Master Mechanics' association would attend the meetings of the society.

The first report presented was that of the committee on "Size and Capacity of Safety Valves," of which F. M. Gilbert, of the New York Central, is Chairman. This was accompanied by a minority report presented by Mr. Milliken.

Discussion on Safety Valves.

J. F. Walsh (C. & O.): I move that the recommendation contained in the minority report be adopted. (Motion seconded.)

F. F. Gaines (Cent. of Ga.): I would suggest that emphasis be laid on the recommendation as to making tests, as considering both the majority report and the minority report, it is very evident there is a lack of data on the whole subject. If it is a possible thing we should have some tests to determine the proper location and the most desirable amount of lift, and to develop formulas.

E. D. Nelson (P. R. R.): During the St. Louis tests, under some conditions, it was difficult to prevent the safety valves blowing, and it was necessary to have calibrations of all the safety valves on the boilers in order to determine the amount of water lost per second. We did not keep a record of the names of these valves, but the average amount of water passed per second by all the valves tested at St. Louis was 1.29 pounds, and since we have had the plant at Altoona we have found it to be 1.6 pounds per second.

We made a test very recently—since this report was written—to see what the condition would be with the locomotive running at about the capacity of the boiler, and suddenly shut off, and we found under those conditions that the 4-inch safety valve which we are using passed 2.4 pounds of water per second.

P. H. Peck (C. & W. I.): My experience is that—especially in bad water districts—it is necessary for the boilers to be relieved very gradually. I think the committee should take into consideration the use of different kinds of water in the test. If the boiler is gradually relieved, and gradually shut off, it is much better than when relieved suddenly and shut off suddenly.

F. M. Gilbert (N. Y. C. & H. R.): The only important point at issue, as I see it, is the question—what constitutes the most exacting conditions for the safety valve. The report simply lowers the high points and raises the low points on existing practice, which seems to have given pretty good satisfaction. There is a danger, possibly imaginary, that boilers equipped with a certain number of valves, of certain sizes, which have a certain outlet, may have their valves changed, so as to get valves of the same nominal diameter and possibly not more than one eighth of the outlet of the original equipment, and, under these conditions, we will get into trouble, but if we can establish a relation between the work to be done, and the outlet which is to do it, I think no serious trouble need be apprehended. If this committee is continued, and it is expected to accomplish anything, it will be necessary that we get a more prompt response from those in position to furnish information.

H. H. Vaughan (Can. Pac.): Did Mr. Nelson find any difference in the different styles of safety valves as to the rate of discharge?

Mr. Nelson: We have no information in regard to that. We did not keep a record of the names of the valves on the engines tested in St. Louis, and up to this time we only tried one valve which we are using, but with 2.4 pounds per second, with two such valves as we use, that would correspond to 6.54 pounds per square foot of heating surface, whereas the committee recommends 5.28. The committee's recommendation is very close, probably, to what is necessary.

H. H. VAUGHAN.
President-Elect Master Mechanics' Association.

In the St. Louis tests the water passed averaged from .347 pounds per second, to 2.95 pounds per second. The relief provided is largely a matter of the idea of the builder.

Mr. Walsh's motion was carried.

The report on "Revision of Standards" was then read by W. H. V. Rosing.

Discussion on Revision of Standards.

C. A. Seley (C. R. I. & P.): Would it not be better, with reference to the naming of M. C. B. standards to state the latest M. C. B. standard in all cases, instead of specifying the M. C. B. proceedings of 1907? I think that the standards of the Master Mechanics' association should conform to the M. C. B. standards.

Mr. Miller: It is recommended that the standard for pipe unions be continued without change. The difficulty that we find is that the manufacturers of pipe do not work to the same standards, and we do not get any two pipe fittings of the same size. In repair work this causes a good deal of inconvenience and waste. I would like to see an effort made to bring the pipemen to standard size.

Mr. Vaughan: Is there any change in recommendation for shrinkage allowance of tires?

Mr. Rosing: The standard is 1-30 inch under 66 inches and it is 1-80 of an inch for all wheel centers over 66 inches. We thought a uniform scale such as is shown on the diagram would be better.

Mr. Vaughan: That gives as many sizes as there are wheels.

Mr. Rosing: Inasmuch as those dimensions are all expressed in thousandths or ten thousandths of an inch, we thought it would be just as easy to make a gage to one figure as another, and so far as shop practice is concerned, it will be always done by gage, and the mechanic turning the wheels will not have any occasion to make any measurements himself.

The committee no doubt will be glad to accept Mr. Seley's recommendation and it was our view that in reference to anything of the Master Car Builders' Standards, we should use the very latest, and incorporate any changes made at this convention of the Master Car Builders' Association in these proceedings, instead of specifying the 1907 report.

On motion the report was ordered referred to letter ballot.

The report of the committee on "Subjects" was received and referred to the executive committee.

J. J. Hennessey (C. M. & St. P.): There has recently been a federal law passed regarding the type of ashpan to be used on locomotives. Would it not be well for the committee report on that subject?

Mr. Manchester: I believe it would be wise for this convention to instruct the executive committee to confer with the American Railway Association the question of how far we should investigate this matter.

The topic: "Standardization of Locomotive Parts," was then discussed. This was opened by G. R. Henderson.

After the topical discussion on "Advisability of using ball joint unions for air and steam pipe connections on locomotives and tenders," the report on "Various Designs of 4-Cylinder Compound Locomotives in Service" was presented by E. D. Nelson, chairman of the committee.

Discussion on 4-Cylinder Compound Locomotives.

G. R. Henderson: It occurs to me that some years ago it was found necessary in running large compounds down hill to use a certain amount of steam on account of the back pressure. Are these balanced compounds in the same category and is it necessary to use steam running down hill?

Mr. Nelson: The committee has had no information on that point.

S. M. Vauclain (Baldwin Locomotive Works): If you will go over the report carefully, and consider merely the matter of coal and steam consumption, you will find a few very conclusive figures. The steam consumption per indicated horsepower at about 800 horsepower shows a percentage of saving of 24 per cent. It will also be noticed that the faster the compound engine is operated that the lower percentage of steam economy will be. That is what has been proved in service every day since we commenced to use compound locomotives, and has always been the claim of every reputable builder of compound engines. The The percentage of saving per dynamometer horsepower is also in accordance with the steam consumption per indicated horsepower, and at the mean power of 800 horsepower shows only 25.5 per cent. Referring to the matter of coal consumption you will find that we have percentages of economy per indicated horsepower ranging from 38 to as high as 54.10 per cent. These percentages of coal economy have been taken off a standard apparatus, where every appliance we know has been made use of to get a careful and accurate record. In the old days any one who came before the convention and talked about a saving of 30 to 40 per cent in coal was looked upon with some amusement, and there was considerable doubt as to the accuracy of his figures. In coal per dynamometer horsepower, we find a saving of from 39.6 to 50.5 per cent. Unfortunately, in the locomotive engines compared, the single expansion engine was not capable of being carried to the same high horsepower that was obtained from the compound locomotives. This is not due entirely to the fact that one engine had compound cylinders and the other had not, but the Pennsylvania single expansion locomotives were handicapped by not having as much heating surface as the boilers of the compound locomotives. So far as the Santa Fe locomotive is concerned, they had about 20 per cent less, but there is a difference, under maximum conditions of 50 per cent in round figures, in these two engines, 20 per cent of which might fairly be attributed to the fact that the one engine did not have so much heating surface.

When figures are presented to you, which show that a single expansion locomotive has as its limit about 1,000 horsepower and that compound locomotives of virtually the same weight can be carried to 1,600 horsepower, it proves that not only have compound locomotives been economical from the time economy was claimed for them, but that boiler capacity must be considered, as it has been considered in the past, in relation to single expansion locomotives.

These figures explain why reports have been presented to you from time to time, showing that Atlantic type balanced compounds were capable of hauling the same trains that Pacific type single expansion locomotives hauled, and making better time with them, or that they were capable of hauling much heavier trains than a single expansion Pacific type locomotive could haul, and make the same schedule time. This was due merely to their having an increased amount of heating surface in addition to having compound cylinders.

I think that balanced compound and Mallet compounds will still continue to be built—but that the superheater locomotive will perhaps take the place of the majority of locomotives in railroad service.

F. H. Clark (C. B. & Q.): We have 20 balanced compound locomotives, the first of which went into service about four years ago. Most of them have built-up crank axles and all of them had the outside cylinders connected by main rods to the rear driving axle. The results of service have been on the whole very satisfactory. We think that the locomotives take a little more time in the round house than the simple engine does, but we seem to have time to do this, and as a consequence the engines make good mileage and make their mileage with very few road failures. I was somewhat surprised that the committee did not make more of a certain feature of the balanced compound locomotive which I think is an important thing with that type of locomotive, and that is the effect on the track. We found that it was possible to balance these locomotives in such way that the disturbance to the track was very much less than with a simple locomotive of the same type properly counterbalanced and of less total weight. The weight on drivers of the balanced compounds is about 20 per cent more, yet the disturbance and the effect on bridges was considerably less than in the case of the simple locomotive.

Wm. Forsyth (Railroad Age Gazette): The committee has stated one important conclusion here in regard to fuel economy, which is that when developing 800 dynamometer horsepower the compound uses 2.7 pounds of fuel per draw bar horsepower and the simple engine 4.85, a difference of 80 per cent. This is the pre-eminent conclusion as to the economy of the balanced compound locomotive. It is stated that this is obtained when developing 800 horsepower, but it should be remembered that the 4-cylinder compound is primarily and essentially a high-speed locomotive. It was developed with that purpose in France, and is running there on most of the State roads on high-speed service and has been used in this country in high-speed service.

Mr. Vauclain's locomotive, the first 4-cylinder compound, made a remarkable record here between Atlantic City and Camden for high speed, but there has been little said about the economy of those engines at that high speed, and if you will look at the curves in this report, you will find when you get up to 1,200 and 1,400 and 1,600 horsepower that the curve rises quite rapidly, and you begin to appreciate the economy of the simple engine.

If you will refer to the report which was made to this association in 1906, and note the figures showing the effect of speed on the fuel economy of locomotives, you will find that on the New York Central it was 2.75 at 18 miles, 4.5 at 56 miles, and 4.65 at 75 miles. There are conditions of speed where the fuel consumption is doubled, so that the criticism I would make of the committee's report, is that this important element of speed should have been considered when it draws any conclusions in regard to fuel economy.

A very interesting point in regard to 4-cylinder compound locomotives mentioned by the committee is the increased capacity, and I think the reason is that you can work more steam through the cylinders, because there is such a large port area. Regardless of the economy there is an increased capacity for the same size engine, and for that reason I am surprised that Mr. Vauclain is ready to give up this type in favor of the superheater engine. While the superheater may give economy, it will not add as much to the capacity of the locomotive as the four cylinders. There are places where it is important to get heavy trains over the road, regardless of fuel consumption, and those are the places where a 4-cylinder compound ought to be a desirable machine.

C. A. Seley (C. R. I. & P.): I take issue with Mr. Forsyth in saying that the superheater engine does not have a greater power than a non-superheater for the same size cylinder. It has been very conclusively demonstrated by the use of superheater engines, that even though by reason of poor coal and an imperfect superheat, resulting in the reduction of some considerable amount below the normal boiler pressure, yet these superheating engines can take the train over the road at a speed which was marvellous, and I think Mr. Vauclain has a very good basis for his preference for the superheater engine, for a number of classes.

Mr. Vauclain: Mr. Forsyth said he regretted I was willing to give up the balanced compound for a superheater engine. I do not give up anything. I am not built that way. If you will refer to this report, I think that you will find that some of the things which Mr. Forsyth mentioned have been considered.

It is true that compound locomotives are capable of hauling greater trains at high speeds than single expansion locomotives, and for that reason many railroads are holding on to that class of power for that service; but I am absolutely convinced from my experience of the past few years that superheater locomotives possess that faculty to about the same extent, if not a greater extent, than the compound locomotives.

Mr. Seley: I am sorry Dr. Goss is not present to-day, but I recall a remark made by him that across the water they compared the superheater engines with the compound, and not with the simple engine. They are not in the same class.

R. C. P. Sanderson (Virginian): In connection with the use of the simple superheater engines, I collected indicator cards taken from engines of that kind recently, and I found they showed a remarkably high average mean effective pressure throughout the stroke, more than I expected to find and more than I believe is common with the simple engines. It is natural it should be so, if you stop and consider it, and therein lies the increase in power developed by the engine for some speeds and cut-offs.

A. E. Manchester (C. M. & St. P.): Referring to Mr. Vauclain's remarks about the good old days of the compound discussion, the compound engines on the St. Paul to-day are doing all that was claimed for them in the good old days. As to the greater power exerted by the compound engine, we had a very vivid and practical illustration. In the diagramming of our locomotives, we allow each locomotive a percentage. In a certain passenger service engines which were classed as 118 per cent engines were not able to do the work. They were simple engines. We put 90 per cent engines of the compound type there; and they have held that service right up and given good service.

Mr. Nelson: This report presents to the association comparative figures on locomotive testing plants. Many consider these laboratory figures, and in a sense they are; but you all understand how a locomotive is run, and the only practical difference between the testing plant condition and the road condition is that we can run without variation in speed and without upsetting the fire and all the sort of things that often occur in road trials. This report calls attention to the possibility of a very considerable saving by using compounds.

J. F. DeVoy (C. M. & St. P.): I am satisfied that the friends of the compound had done it more harm than all other people put together. Mr. Vauclain made the statement yesterday that a Mallet compound would do a hrosepower on 20 pounds of dry steam per hour. I do not believe that the engine has ever been built or ever will be built that will do it.

I read in the report: "This saving of the compound over the simple locomotive is shown to be about 24 per cent." There would not be a simple locomotive on the American railroads today if this were the case. A compound locomotive will save, generally, from 18 to 25 per cent in fuel under all conditions.

Mr. Vauclain: I was correct yesterday in stating that a compound locomotive could do on 20 pounds of dry steam per indicated horse power and in support of that testimony Mr. DeVoy is referred to this report.

Mr. Sanderson: I don't want too much cold water thrown on statements in this report, and it is distinctly stated in two places in this report that those are testing plant conditions. We are pretty safe in saying that those figures are right for the testing plant, but we do not say they are right for the road. Furthermore, the St. Louis tests, which are published partly on the authority of a committee from this association, show compounds can be operated on 20 pounds.

The Secretary: Prof. A. W. Smith was not able to be present and he sent the paper by express to Professor Hibbard. Professor Hibbard had to leave yesterday morning and we have been unable to locate the paper on "The Training of Technical Men." I suggest that when the paper is received it be printed in the proceedings, after it is approved by the executive committee. A motion to this effect was carried.

The "Auditing" committee reported that it had examined the books of the association and found them correct in every particular. (Report received and adopted.)

The report of the committee on "Resolutions" was adopted as follows:

Report of Committee on Resolutions.

Whereas, the forty-first convention of this association has been one of the most successful in its history, the attendance being 10 per cent greater than last year, and whereas, the exhibits occupied seven per cent more floor space, with corresponding improvement in value and in appearance; be it

Resolved, that the hearty thanks of the association be extended to the president for his admirable address, the officers of the association, and especially the secretary, for the painstaking preparations and conscientious efforts in every detail of the conduct of the sessions; to the technical committees and authors of papers for their effective service; to the committee of arrangements for providing so satisfactorily for the meetings; to the railroads for courtesies extended; to the hotels and business men of Atlantic City for their entertainment to the Railway Supply Manufacturers' Association for their efforts to render the exhibits valuable and instructive, to the technical press in general for their interest and support and to the Daily Railroad Age Gazette for prompt reports of the discussions.

Whereas, the regular appearance of daily reports of discussions at these conventions for many years is due to the unselfish and untiring energy as well as the ability of Hugh M. Wilson in the publication of the Daily Railway Age. Whereas, Mr. Wilson has retired from journalism; as a mark of appreciation of these efforts, be it

Resolved, that the thanks of the association be extended to him personally, together with best wishes for his continued prosperity, good health and happiness.

G. M. BASFORD,
L. R. POMEROY,
A. E. MITCHELL,
Committee.

C. A. Seley (C. R. I. & P.): There has been some little talk about the delay in receipt of the reports of not only this association, but also of the Master Car Builders; and I would like to say, as a most frequent visitor to the office of the secretary that it is due to the fault of the members and not of the secretary. You can investigate that matter for yourselves, by looking up the date of the signature of the reports. Very large, heavy reports were sent in at the last moment, with blue prints to be reproduced and that sort of thing, and a number of reports were not ready even at the very late date that the reports were made. I, therefore, move that the executive committee advise the secretary to have all papers printed that are received by May 15 after they have been listed and approved by the executive committee and that the papers received after that time be presented at the convention; also that a copy of this resolution be forwarded to the executive committee of the Master Car Builders for their information.

Motion carried.

The President: The election of officers is the next business in order.

F. H. Clark (C. B. & Q.): The association honored me last year by electing me to the position of third vice-president. As things have usually gone in the past it has been customary to move the various vice-presidents up and I simply want to say that circumstances have arisen which make it inadvisable that I be continued in the line of promotion. I wish to prevent in this way the use of my name and ask that I be not considered a candidate for vice-president.

The following is the result of the election:

Officers Elected.

President, H. H. Vaughan, assistant to vice-president, Canadian Pacific.

First vice-president, G. W. Wildin, mechanical superintendent, New York New Haven & Hartford.

Second vice-president, C. E. Fuller, assistant superintendent motive power and machinery, Union Pacific.

Third vice-president, J. E. Muhlfeld, general superintendent motive power and machinery, Baltimore & Ohio.

Treasurer, Angus Sinclair, New York.

Executive members: H. T. Bentley, Chicago & Northwestern; T. Rumney, Erie; T. H. Curtis, Louisville & Nashville.

William McIntosh (Cent. of N. J.): In surrendering the position of president I wish to thank you all for your uniform forbearance in passing over my shortcomings as presiding officer. Whatever success we have had is owing entirely to this feature and I bespeak for my successor the same kindness and herewith turn over the gavel to Mr. Vaughan.

Mr. Vaughan: It is impossible for me to thank you properly for the honor you have conferred upon me, or explain to you my appreciation of and thanks for your action. While I have not, perhaps, been a member of the association as long as some of the others of you, I don't think there is anybody who has a deeper interest in the well being of the Master Mechanics' Association than I have; and it will be my pleasure and endeavor to carry on as well as possible the work of those who have preceded me, and use my best endeavors for the prosperity and furtherance of the objects of this society.

Mr. Sinclair: I wish to propose a hearty vote of thanks to our retiring president, Mr. McIntosh. We can think of his work as efficient in every line that he has been engaged in for the association, in his presiding over the meetings, in his work on the executive committee and his work as a general member of this association. I am sure that every one heartily approves of the manner in which Mr. McIntosh has performed his duties, and I think it would be very proper to put this motion as a rising vote.

Motion carried by a rising vote.

President Vaughan: I introduce Mr. Walbank, the president of the Railway Supply Manufacturers' Association, who has a very pleasant duty to perform.

Mr. Walbank: A very pleasant and profitable season of the annual convention of June, 1908, is about closed. We

have met under business conditions not as auspicious as in some previous years, but we have had a very satisfactory attendance and we have all had a good time and hope that next year we shall meet under brighter commercial skies.

The Railway Supply Manufacturers' Association expresses through me its appreciation of the courtesy and careful attention shown to the exhibits prepared for your two mechanical associations. I have a few words to say, with your kind permission, to your retiring president, Mr. McIntosh: The consciousness of honors deserved, of work faithfully and ably done, and of retirement, and the praise and affection of those whom you have served is yours. I am the glad agent of your admiring friends among the supply men, who bid me present this past president's badge.

Mr. McIntosh: As president of the Railway Supply Manufacturers' Association, I thank you sincerely for this kind memorial of the occasion and I want to say that no Frenchman will wear the badge of the legion or honor, or German wear the iron cross with any greater pride than I will wear this badge of the Master Mechanics' Association.

Adjourned.

Additions to Master Mechanics' Roll Call.

Clark, F. H., G. S. M. P., C. B. & Q., Marlborough-Blenheim.
Davis, David E., M. M., Boston & Maine, Rudolph.
Dewey, J. J., M. M., Erie, Dennis.
Dillon, S. J., M. M., Pennsylvania, Ariel.
Edmonds, G. S., M. M., Dela. & Hudson Co., Dennis.
Hainen, J., C. M. M., Southern, Dennis.
Jennings, Thos., M. M., Boston & Maine, Grand Atlantic.
Lanza, Gaetano, Mass. Inst. of Technology, Boston, Mass., Traymore.
Machesney, A. G., Baldwin Loco. Wks.
Nelson, E. D., E. of T., Pennsylvania, Pennhurst.
Quigley, Jos., M. M., C. N. O. & T. P. Ry., Dennis.
Small, H. J., G. S. M. P., Southern Pacific, Marlborough-Blenheim.
Smock, F. A., C. F., Penna. R. R., Meadows, N. J.
Street, Clement F., Westinghouse Air Brake Co., Pittsburg, Pa., Marlborough-Blenheim.

Briquet Fuel Tests on Southern Railways.

The technologic branch of the United States geological survey publishes the following results of tests of briquet fuel made within the last six months:

The Atlantic Coast Line, after giving the new fuel a thorough trial on a number of runs between Rocky Mount and Wilmington, N. C., reported that the briquets were a success; 172,700 pounds of coal were consumed in making 10,912 car-miles against 161,980 pounds of briquets in making 12,896 car-miles. The engine that used coal made up 231 minutes lost time and the engine on which the briquets were tried made up 292 minutes. This is an apparent economy of 20 per cent. without taking into consideration the cost of the briquets. In describing the results of the tests the road foreman reported: "This coal burns up entirely, leaving no dirty fire at the end of each trip, saving 30 minutes' time in cleaning the engine. The briquets do away with all black smoke while using steam and there is but little smoke when the steam is turned off. This fuel does away with the stopping up of the flues and produces a uniform steam."

Officials of the Chesapeake & Ohio made the following report on the use of briquets: "The briquet ignites very freely, making an intensely hot fire. When the engine is working there is very little smoke. A heavy fire may be carried as there is no danger of clinkering. Very little ashes are left." The tests on the Chesapeake & Ohio were made on the through trains between Washington, D. C., and Charlottesville, Va., during the rush of Christmas travel.

The results of a number of the investigations made at the fuel testing plant of the government at St. Louis, Mo., have just been published by the geological survey under the title of "Binders for Briquets." The author of the bulletin, James E. Mills, states that the object of the investigations was to determine as far as possible to what extent the manufacture of briquets from slack coal may succeed commercially under the conditions existing in the United States. The main problem in briquetting, says the author, is to find a suitable binding material at sufficiently low cost. When the difference in price between slack coal and the first-class lump is $1.00, the cost of briquetting should not exceed this amount.

Conventionalities

Henry C. Carpenter, third vice-president of N. Z. Graves Company of Philadelphia, New York and Chicago, attended the conventions.

Henry J. Bellman returned from the West in time to mingle with his friends and again explain why it is necessary to use hair felt in insulating refrigerator cars. His able staff of assistants, Mrs. Bellman, Miss Margaret and M. J. Murphy, have entertained with him at the Traymore.

The Excel coupler exhibited by the Scullin-Gallagher Iron & Steel Company was designed by a pioneer coupler man, James Timms, who is attending the convention. He and the representatives of the company will be glad to explain the operation of the coupler to visiting members.

The cover of the attractive programme for the Master Mechanics' ball on Tuesday night had upon it an engraving of a locomotive. The name of William McIntosh, president of the association, appeared on the cab, the words "Atlantic City" appeared on the tender, and above them were the initials "A. R. R. M. M. A." On one side of the headlight was "1908."

One of the most interesting events in the history of the Master Mechanics' convention just closed as well as one of the most interesting political contests which has ever been carried on in any non-political organization was in connection with the election of treasurer. Angus Sinclair was the previous incumbent and displayed considerable nervousness as the counting of the ballots progressed. The tellers' voices as they counted the votes were quite audible to Mr. Sinclair and the other officers of the association, and increasing nervousness was depicted upon all countenances. Those who sat near enough to the tellers' table heard something like this: "Sinclair, Jones, Jones, Jones, Jones, Jones, Sinclair, Jones, Jones," etc. Everybody wondered who Jones might be, as he had up to this time not shown himself as a conspicuous candidate for treasurer of the association. Upon the call of the president for the report of the tellers Mr. Gaines announced, Total votes cast, 67; Angus Sinclair 66, one scattering."

Secretary and Committees Supply Men's Association.

The executive committee of the Railway Supply Manufacturers' Association for 1909 met at the Marlborough-Blenheim on June 23 and after the transaction of some routine business, re-elected Earl G. Smith secretary of the association for the ensuing year and appointed the following finance and exhibit committees and chairmen of other committees:

Finance Committee—Samuel G. Allen, chairman; S. P. Bush, Edward M. Grove.

Exhibit Committee—Thomas Aldcorn, chairman; F. A. Morrison, L. R. Phillips.

Entertainment Committee—Charles P. Storrs, general chairman.

Enrollment Committee—W. W. Rosser, chairman.

Transportation Committee—Harry Quest, chairman.

The secretary was instructed to secure permanent headquarters for the association at Chicago, the headquarters to be as near as may be practicable to the office of J. W. Taylor, secretary of the mechanical associations.

It is reported that the Western Railroad Company has given directions to cut down all telegraph poles which lean so as to endanger the lives of brakemen on the tops of trains. —The Silver Standard, June, 1847.

APPRENTICESHIP SYSTEM.*

Your committee, recognizing the fact that there is a wide difference in organization and local conditions as to available material and facilities for instruction, considers that a hard-and-fast general apprenticeship code is impracticable, and, therefore, suggests the discarding of the code adopted in 1898 and the substitution of basic principles rather than a formal code.

To assure the success of the apprenticeship system, the following principles seem to be vital whether the organization is large or small:

(1) To develop from the ranks in the shortest possible time, carefully selected young men for the purpose of supplying leading workmen for future needs, with the expectation that those capable of advancement will reveal their ability and take the places in the organization for which they are qualified.

(2) A competent person must be given the responsibility of the apprenticeship scheme. He must be given adequate authority, and he must have sufficient attention from the head of the department. He should conduct thorough shop training of the apprentices, and, in close connection therewith, should develop a scheme of mental training, having necessary assistance in both. The mental training should be compulsory and conducted during working hours, at the expense of the company.

(3) Apprentices should be accepted after careful examination by the apprentice instructor.

(4) There should be a probationary period before apprentices are finally accepted; this period to apply to the apprentice term if the candidate is accepted. The scheme should provide for those candidates for apprenticeship who may be better prepared as to education and experience than is expected of the usual candidate.

(5) Suitable records should be kept of the work and standing of apprentices.

(6) Certificates or diplomas should be awarded to those successfully completing the apprentice course. The entire scheme should be planned and administered to give these diplomas the highest possible value.

(7) Rewards in the form of additional education, both manual and mental, should be given apprentices of the highest standing.

(8) It is of the greatest importance that those in charge of apprentices should be most carefully selected. They have the responsibility of preparing the men on whom the roads are to rely in the future. They must be men possessing the necessary ability, coupled with appreciation of their responsibilities.

(9) Interest in the scheme must begin at the top, and it must be enthusiastically supported by the management.

(10) Apprenticeship should be considered as a recruiting system, and greatest care should be taken to retain graduated apprentices in the service of the company.

(11) Organization should be such as graduated apprentices can afford to enter for their life-work.

For the purpose of obtaining data as to the conditions on various roads of the country, information was secured which is summarized as fololws:

1. A shop plant for the purpose of this report is one in which general repairs of locomotives or cars are made. Fifty-five roads report 301 shop plants having apprentices.

2. Fifty-five roads report 67 shop plants in which there are no apprentices.

3. Fifty-five roads report a total of 7,053 apprentices in shop plants.

4. Fifty-five roads report apprentices in each trade as follows:

Machinists	4814	Molder	82
Boilermakers	952	Electrician	14
Blacksmiths	311	Painter	137
Patternmaker	64	Upholsterer	27
Cabinetmaker	22	Carpenter	249
Tinner-pipefitter	365		

5. Reports from 55 roads show the average ratio of apprentices to mechanics in each trade to be as follows:

Machinists	1 to 4.8	Molder	1 to 8.2
Boilermakers	1 to 6.8	Electrician	1 to 8.6
Blacksmith	1 to 13.9	Painter	1 to 19.2
Patternmaker	1 to 3.3	Upholsterer	1 to 11.3
Cabinetmaker	1 to 23.3	Carpenter	1 to 72.4
Tinner-pipefitter	1 to 5.1		

6. The majority of replies indicate difficulty in securing apprentices in some of the trades, but no difficulty in others. A few replies state no difficulty in securing apprentices. This is apparently due to local conditions.

7. Out of a total of 55 replies, 10, or 18.2 per cent, indicate special instruction in trades is given apprentices. Forty-five replies, or 81.8 per cent do not provide for special instruction.

8. Out of a total of 55 replies, 16, or 29 per cent, indicate an established school system and 39, or 70.9 per cent, have no school system.

9. Out of a total of 55 replies, 39, or 70.9 per cent, have apprentices and no school system, and eight roads state that they intend to establish such a system.

10. Eighteen replies favor day schools and three, or 14.3 per cent; favor night schools out of a total of 21 replies.

11. Fifteen replies show 37 schools with 1,567 apprentices attending. Most of the schools were recently established.

12. Of these schools, 28 are held in working hours and nine are held in the evening.

13. Of these schools, 34 are compulsory and three are optional.

14. Out of 55 roads, 12 pay the apprentices for time spent in school.

15. Modern apprenticeship training has been introduced in 17 shops on four roads with 506 apprentices since the convention of June, 1907. The following roads and systems of roads have made substantial progress in this work.

			No. Apprs.	Estab.
Union Pacific	1 school.	Omaha	71	9-1-06
	1 "	Cheyenne	21	12-1-07
Michigan Central	1 "	St. Thomas	36	12-1-07
Santa Fe	10 schools.	....	363	1908
Southern Railway	1 school.	Knoxville, Tenn.	...	1907
	1 "	Spencer, N. C.	...	1907
Delaware & Hudson	3 schools.	Green Isle, Oneonta, Carbondale	86	1907

Substantial progress has also been made on roads having schools previously established, on the Grand Trunk, Central of N. J., Boston & Maine, Union Pacific, Minneapolis St. Paul & Sault Ste. Marie and New York Central lines.

The Canadian Pacific and the Erie advise that they intend to install the improved plan of apprenticeship during the present year. Other important roads have the subject under contemplation.

These replies cover apprenticeship which is both new and old, some of the statements coming from roads of many years' experience.

The new apprenticeship, which combines instruction in the trade with mental training, is progressing rapidly on railroads, as described in answers to Question 15.

The results of these questions show how large a field is available for the new apprenticeship, as well as illustrating the extent of the present development.

Your committee believes that the strongest part of this report is embodied in the practical exhibit of apprentice training and methods in Booth No. 67 on the pier. This exhibit illustrates the development of the several roads in this matter up to date. The exhibit is worthy of most careful study, and your committee believes that the exhibit itself speaks in a far more definite and practical way of the details of the methods which are being employed than could possibly be put into words in even a very long report.

Your committee recommends that the association provide an appropriation for establishing an exhibit of apprentice training to be a feature of each convention.

Your committee wishes to gratefully acknowledge the co-operation of the Railway Supply Manufacturers' Association in making the present exhibit possible.

It has often been said that apprenticeship is a thing of the past. This certainly is not true of American railroads to-day, where a new apprenticeship has sprung up and has attained a healthy growth with brightest promise for the future. Your committee does not hesitate to characterize the new apprenticeship as the most important influence introduced into railroad organizations during the present generation. This development is sure to be rapid, requiring great wisdom, combined with conscientious and systematic efforts in its control. We believe this movement will become the most powerful influence in supplying and preparing the men of the future for the motive power departments (and perhaps other departments) of American railroads; because the movement trains men in the ideal way, and because men properly prepared for their work constitute our greatest problem to-day.

The foregoing report is unanimous, except that in principle No. 2 Mr. Robb favors evening classes at the expense of the company instead of day classes.

*Abstract of a report presented at the annual convention of the American Railway Master Mechanics' Association at Atlantic City, N. J., June, 1908, by a committee consisting of C. W. Cross, B. P. Flory, G. M. Basford, A. W. Gibbs, John Tonge, W. D. Robb and F. W. Thomas.

Appendix—Recent Progress of Apprentice Training in England.

By W. B. RUSSELL.

Manufacturers and railroad managers in Great Britain have long been alive to the apprentice situation and have developed a number of successful systems embodying advanced and novel ideas. The subject has been given more careful consideration and fuller discussion than in this country and that more general results have not thus far been produced, is probably due to the natural conservatism of an older community and to the hereditary idea of class or caste, evidenced in the retention of many firms of the premium apprentice, a young man paying for the opportunity of entering the shop and usually given special privileges in learning the business. There still remain also in many cases long term apprenticeships of from five to seven years.

The British system of evening technical schools is such that each manufacturing center may be said to have its "Cooper Union." These district technical institutes, as they are called, are usually maintained jointly by grants from the educational board, by railroads and manufacturers, and to a small extent by the nominal fees charged for instruction. The use of such schools by firms having apprentices is quite general.

Several establishments make it a practice to excuse apprentices for six months of each year for attendance at day technical schools, crediting the time lost on the apprentice term, but it should be remembered that in such cases the apprenticeship is usually seven years. Both railroads and manufacturers appear to be united in placing emphasis on the value of technical education, and the offering of prizes for high scholarship in evening classes is a common practice.

The Lancashire & Yorkshire has built a mechanics' institute at Horwich, a point which is the location of large shops. Apprentices are supposed to attend evening classes at a nominal fee, and as a reward for progress, thirty boys are selected each year for free instruction during company time for two half-days per week. The teachers are mainly from the railway company and the character of the instruction is such that many outsiders take the courses, paying increased fees.

The Great Western has day and evening courses with engineering and trade classes in the local technical school at Swindon. About 45 per cent of the apprentices attend these classes. After one year in shop, apprentices may compete for day scholarships, consisting of instruction for two half-days weekly extending over 26 weeks per year for three years, the railroad paying wages for the time spent at school, also the school fee. The subjects taught are practical mathematics, practical mechanics, geometrical and machine drawing, heat, electricity and chemistry. The number of scholarships at any one time is limited to 30. In addition a limited number of apprentices are allowed to attend day classes, two afternoons per week of three hours each, without pay, and paying their own school fee. Apprentices taking full evening courses have the liberty of being late for shop the following morning.

For over 60 years the London & Northwestern Ry. has maintained the Mechanics' Institute at Crewe, where out of a population of 45,000 there are 8,500 men in the railroad shops and roundhouses, besides many in other departments. Schooling is optional except with electrical apprentices, who are paid wages for one afternoon per week instruction. Prizes are offered by the company for progress in evening classes, which are taught, as a rule, by employees. The classes are open to outsiders, but employees are admitted at reduced fees.

Mr. Russell gives data on the educational work undertaken by a number of British manufacturing concerns and continues as follows:

Evening classes versus day classes is already arousing discussion in England. Evening classes have failed to produce the expected results. In a recent paper on the subject one investigator says that a large amount of evening instruction is wasted and recommends that evening schools give assistance to enable a few to train themselves above the average, rather than trying to produce a light crop over a large area and attempting to reach the rank and file. The statement is further made that only a very exceptional youth, strong both mentally and physically, can make any great headway by evening study and at the same time work regularly and well in the shop from 6 a. m. to 5 p. m. In this connection the experience of Cochran & Co. is instructive. In 1903 a three-year course of evening apprentice instruction was started, but in 1905 this was changed to day classes, holding sessions from 8 a. m. to 10 a. m. without deduction of wages. The results have been all that could be wished and the coaxing previously necessary to make boys attend evening class is no longer needed. Prizes are given boys who apply the school training in the shop. Cochran & Co. report a direct benefit in the shop due to school work.

In conclusion it might be mentioned that nearly all the firms which are attempting to solve the apprenticeship question have abandoned the premium apprentice. Attention should also be called to the fact that there is but little reference to methods of handling the shop side of the question and no mention of shop instructors in connection with any of the roads or manufacturers, and it would therefore appear that the problem in Great Britain has been considered almost entirely along educational lines and hardly at all in the shop.

REVISION OF STANDARDS.*

The committee recommended the following changes from the standards of the association as printed in the Proceedings for 1907:

Screw Threads, Bolts and Nuts.—In the formula, on page 354, for diameter of screw at bottom of thread, there should be a decimal point after the 1 in the numerator of the fraction, instead of a comma.

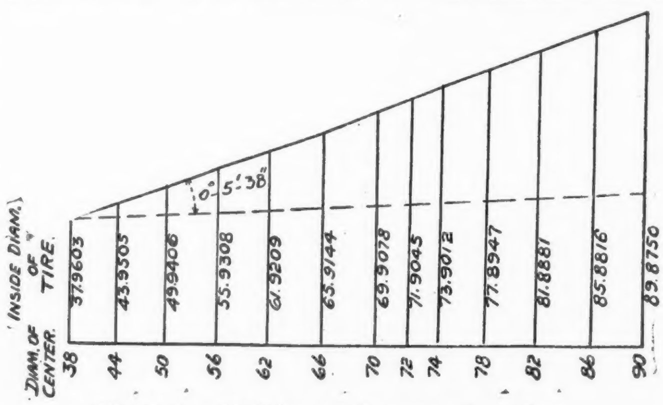
In the table on page 355, we recommend the word "hexagon" be prefixed to the word "nuts" in the heading of the second column, and "bolt heads" in the heading of the third column, and that the table be continued from 2 inches to include 3½-inch sizes.

Proportions for Sellers' Standard Nuts and Bolts.—We recommend that the formula for calculating the dimensions of standard nuts and bolt heads on page 356 be continued unchanged, with the exception of the equation for "rough head," which should read as follows:

"Rough Head = ¾ times diameter bolt plus 1-16 inch."

Distance Between Backs of Flanges.—We recommend the dimensions shown under this item on page 357 to be applicable to steel-tired wheels, either engine truck, driver or tender wheels, and that the M. C. B. standard gauges for cast-iron wheels shown on pages 239, 240 and 241 of the M. C. B. Proceedings, 1907, be used when cast wheels are applied to engines or tenders.

Limit Gauges for Round Iron.—We recommend the figures shown in the table on page 357, and the illustration of gauges, pages 357 and 358, be maintained, with the addition of limits of measurement of iron from 1⅜ inches up to 1⅞ inches in diameter. Round iron two inches in diameter and over should be rolled to the nominal diameter.



Standards—Shrinkage Allowance for Tires.

Section of Tire.—Note.—We recommend the section of tire for steel-tired wheels shown on Plate 1 be changed on tread to conform with the tread of wheel shown on Sheet J, M. C. B. Proceedings for 1907.

Shrinkage Allowance of Tires.—We recommend that the shrinkage of tires should be on a uniform and proportionate basis, and that the dimensions shown in the diagram herewith allowing 1-80 of an inch per foot in diameter of 38-inch centers, and 1-60 of an inch per foot in diameter of 90-inch centers, be adopted.

Standard Dimensions and Threads of Wrought Pipe.—The words "wrought pipe" in the above heading to include wrought-iron and steel pipe.

The dimensions of pipe and threads shown in the present printed table agree with all manufacturers' list, with the exception of the actual inside diameter of the following sizes of pipe: ⅛, ⅜, ½, 1, 2½, 3, 8, 9 and 10-inch, which are shown to be .001 of an inch larger in diameter than the manufacturers' list. We recommend, therefore, that the list be reprinted, and that it include 11-inch and 12-inch pipe.

*Abstract of report presented at the annual convention of the American Railway Master Mechanics' Association at Atlantic City, N. J., June, 1908, by a committee consisting of W. H. V. Rosing, T. W. Demarest and C. B. Young.

Axles.—We recommend that this item be changed to read: "Axles for Locomotive Tenders." We recommend that the dimensions of axles shown in Plate 1 be made to conform to the latest M. C. B. dimensions for axles of corresponding capacity, and that Plate 1 be changed accordingly, and the text of the specifications and test prescribed for axles by the Master Car Builders' Association be added.

Journal-Box Bearing and Pedestal.—We recommend that the pedestal, which is for passenger cars having 3¾ by 7-inch journals and shown on Plate 14 and referred to in first paragraph under this item, be omitted from the proceedings of this association, and that the journal boxes and contained parts for journals 3¾ by 7 to 5½ by 10 be made to conform to the M. C. B. standards.

We recommend that the following specifications be grouped together: For Boiler and Fire-box Steel; Locomotive Iron Tubes; Locomotive Seamless Cold-drawn Steel Tubes; Locomotive Driving and Engine Truck Axles; Locomotive Forgings; Steel Blooms and Billets for Locomotive Forgings; Foundry Pig Iron; Locomotive Cylinder Castings, etc.; Cast-iron Car Wheels, and that the present specifications for all but the last item be continued without change.

For cast-iron wheels we recommend the designs, specifications, etc., be the same as the standards of the M. C. B. Association, and that the form of contract shown on page 398 be eliminated, inasmuch as this is a purchasing, or legal matter, and not within the jurisdiction of the mechanical department. The M. C. B. specifications do not call for a service guarantee, and we consider it advisable to omit this item from the Proceedings, especially as many roads now have guarantees for greater mileage than shown on page 399.

The committee further recommends that:

1. That all names of manufacturers on gauges and the like be omitted.
2. That a committee be appointed to investigate and submit tables showing limits of pressure within which wheels for locomotives and tenders should be pressed on for different sizes of journals, kinds of material in wheel centers and axles, and whether wheels have tires on or off.
3. That a committee be appointed to recommend a standard for safety appliances for locomotives and tenders, in line with the investigation being made by the Master Car Builders' Association for cars.

VARIOUS DESIGNS OF 4-CYLINDER COMPOUND LOCOMOTIVES IN SERVICE.*

It was found impracticable to secure sufficient data obtained from the use of each individual design of balanced compound to permit comparison between these designs, most of them having been in use but a limited time in this country, and it was decided to confine the investigation to a comparison between balanced compounds as a general type, and simple cylinder locomotives.

There are two natural divisions under which this subject can be discussed:

(1.) The comparative economy based on fuel consumed per unit of work done at the drawbar.

(2.) The comparative cost of maintenance.

Reliable data under these two headings, and compared on the same basis, should tell the ultimate economy.

There are, of course, claims made that a 4-cylinder balanced compound is less destructive on track than a 2-cylinder locomotive, but it is so difficult to measure this in cost that it will not be considered from that standpoint.

The comparative fuel used should be based on records from road service, but the committee was not able to secure such data in sufficient quantity to draw conclusions.

The cost of maintenance involves many items, and the committee very carefully prepared a blank covering this phase of the subject, and the railroads having 4-cylinder balanced compounds and simple cylinder locomotives were asked to prepare the information on a uniform basis. Apparently costs and records are kept in different ways, and the data are far from satisfactory.

For the comparative cost of fuel for a unit of work at the drawbar, there are at hand valuable results of the tests on the Pennsylvania Railroad testing plant at the Louisiana Purchase Exposition in St. Louis, in 1904, of 4-cylinder balanced compound locomotives.

Tests more recently made on the same plant at Altoona, with 2-cylinder simple locomotives, fairly comparative in height and general dimensions with those tested in St. Louis, are now for the first time available.

*Abstract of a report presented at the annual convention of the American Railway Master Mechanics' Association at Atlantic City, N. J., June, 1908, by a committee consisting of E. D. Nelson, John Howard, S. M. Vauclain, A. Lovell and J. F. Graham.

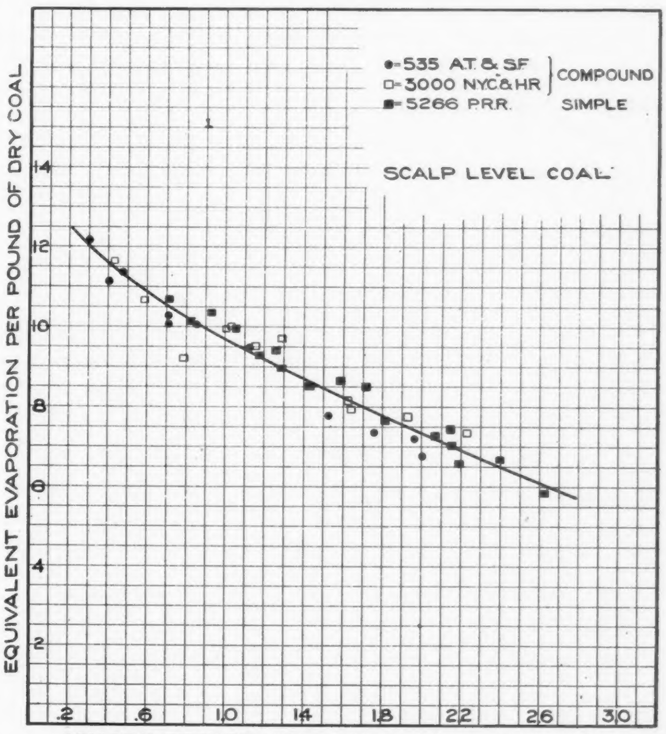
A committee of the American Railway Master Mechanics' Association coöperated with the Pennsylvania Railroad in these earlier tests, and they are the subject of a report made to the Association in 1906.

The Locomotives Tested.

There were four balanced compounds tested at St. Louis. Of these, two were of the lighter class and one of them had a superheater. These two are omitted from the comparisons.

The Atchinson Topeka & Santa Fe locomotive No. 535, and the New York Central & Hudson River locomotive No. 3000, however, were of about equal weight, and in this respect resemble the two simple cylinder locomotives recently tested on the Altoona plant. The accompanying Table No. 1 shows the principal features. Pennsylvania Railroad locomotive No. 5266 was tested, using coal from the same mines as that furnished for the No. 535 and No. 3000 at St. Louis. Locomotive No. 3162 was tested with gas or high volatile coal.

BALANCED COMPOUND LOCOMOTIVES.



Four-Cylinder Compound Locomotives—Figure 1.

It is now possible, therefore, for the first time, to make comparisons of two 4-cylinder balanced compound and two 2-cylinder simple locomotives, operated under testing plant conditions.

These four locomotives differed in minor particulars apart from their simple or compound cylinders, but as already stated, they were of about the same weight and tractive force.

As these locomotives group themselves by results of tests very clearly according to their simple or compound cylinders, and as their boilers gave very similar efficiencies there is no inconsistency in comparing them directly on the basis of cylinder performance.

The two balanced compound locomotives and their tests have been very fully described in the published report of the St. Louis tests entitled "Locomotive Test and Exhibits," St. Louis, 1904.

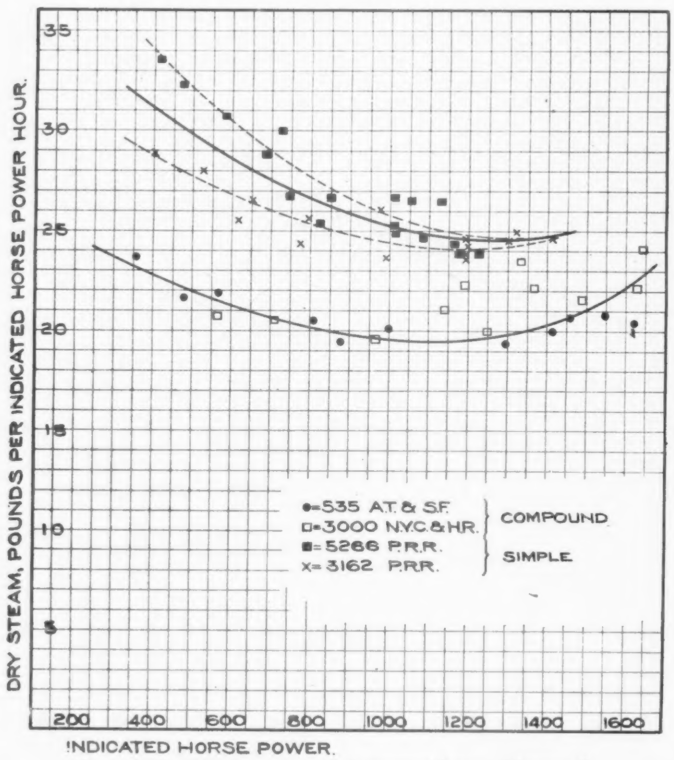
Comparison of Results.

From Figure 2 it will be seen that the steam per indicated horsepower of the compound locomotives tested is more uniform throughout the range of horsepower than the simple engine. The greatest difference is at low horsepower. This saving decreases as the horsepower increases, but if the boiler of the simple locomotive made it possible to continue the test to the maximum horsepower attainable with the compound, there might be more difference.

Inasmuch as the data of these tests for both compound and simple locomotives were taken at various percentages of cut-off at the different speeds, the statement as to relative water rate and horsepower may be considered as obtaining under general running conditions.

From an inspection of Figures 3 and 5, where the performance based on indicated and dynamometer horsepower is shown, as referred to coal, the saving of the compound

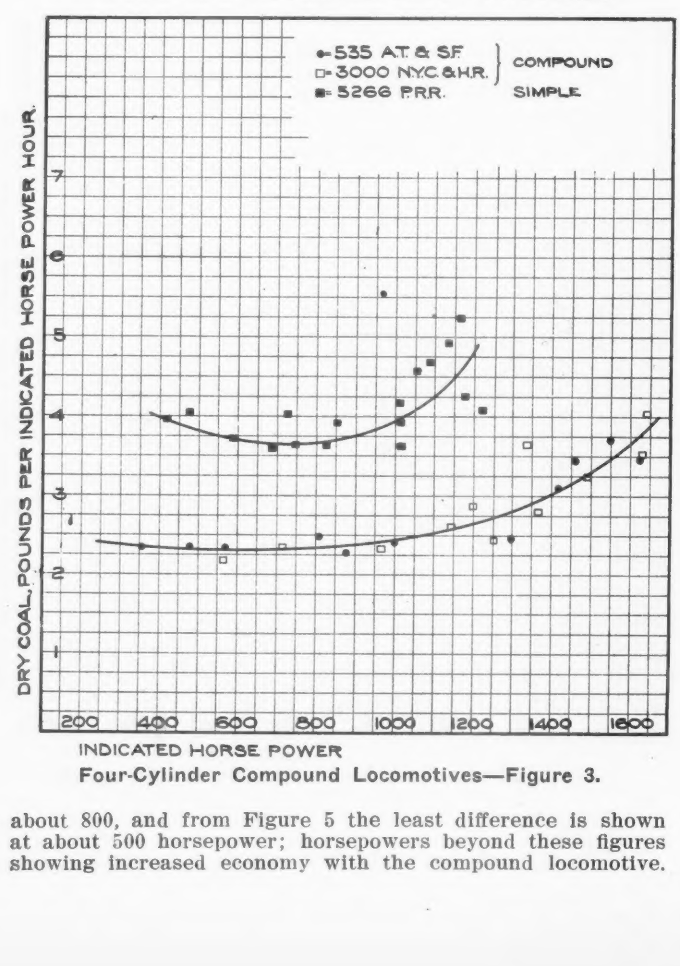
BALANCED COMPOUND LOCOMOTIVES.



Four-Cylinder Compound Locomotives—Figure 2.

throughout its range of action is indicated, and it is to be noticed that at the low indicated horsepowers (Figure 3), the saving with the compound is greater than at horsepowers of

BALANCED COMPOUND LOCOMOTIVES.

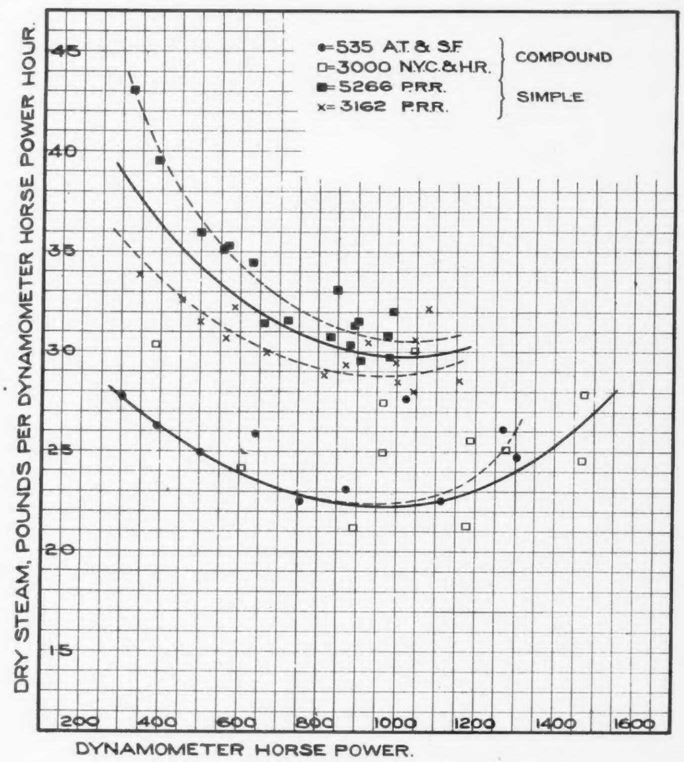


Four-Cylinder Compound Locomotives—Figure 3.

about 800, and from Figure 5 the least difference is shown at about 500 horsepower; horsepowers beyond these figures showing increased economy with the compound locomotive.

The advantage of compounding in adding to the capacity of the locomotive at speeds above those which may be called starting speeds, is clearly indicated. A boiler of the same

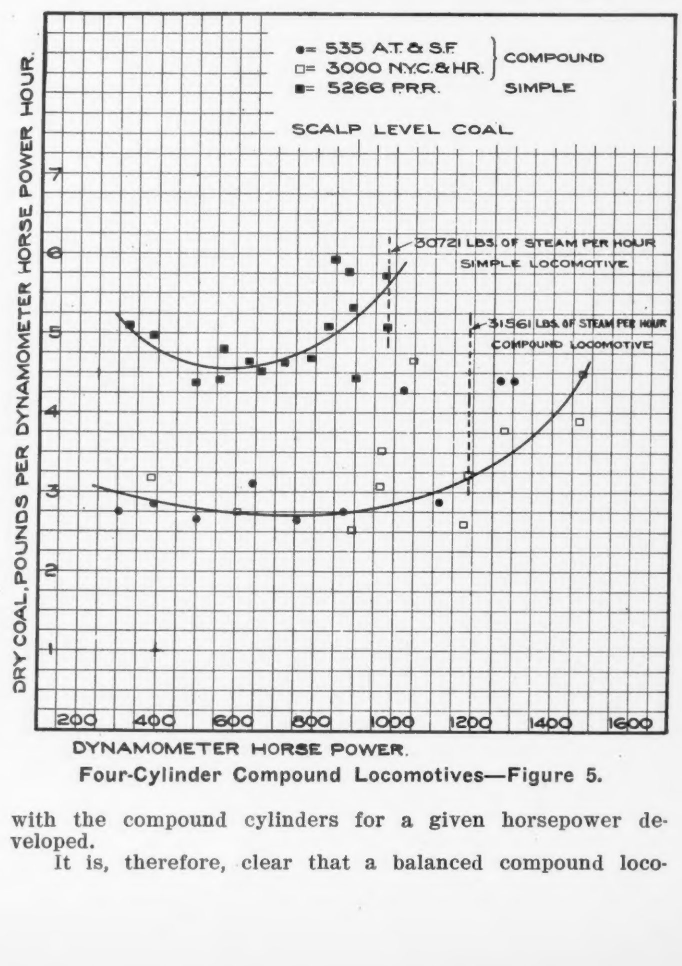
BALANCED COMPOUND LOCOMOTIVES.



Four-Cylinder Compound Locomotives—Figure 4.

heating surface in a locomotive equipped with compound cylinders, has a decided advantage over one equipped with simple cylinders, because the consumption of steam is less

BALANCED COMPOUND LOCOMOTIVES.



Four-Cylinder Compound Locomotives—Figure 5.

with the compound cylinders for a given horsepower developed.

It is, therefore, clear that a balanced compound loco-

motive, while more economical in steam and fuel than a simple locomotive, has also an increased advantage over the simple locomotive in capacity.

When developing 800 dynamometer horsepower, the compound uses about 2.70 pounds of fuel per horsepower hour at the drawbar, and the simple locomotive uses 4.85 pounds. Thus, the saving of the compound over the simple locomotive is shown to be about 44 per cent, based on fuel, this saving varying somewhat with greater and less horsepowers. These figures are based on testing plant conditions.

As indicating the increased capacity with compound cylinders, there is shown on Figure 5 a vertical line where 30,721 pounds of water were being used by the simple locomotive while developing 975 dynamometer horsepower. When the compound locomotive was using approximately the same quantity of water, or 31,561 pounds per hour, 1.188 dynamometer horsepower was developed, an increase of over 11 per cent.

TEST NUMBER	RUNNING CONDITIONS: Test Designation	Duration of Test, Hours	Miles per Hour	Throttle Opening, Full or Partial	Actual Cut-off Per Cent., H. P. Cylinders	BOILER PERFORMANCE: Pressure in Boiler, Lbs. per Sq. Inch	Draft in Smoke Box, Inches of Water	Draft in Ash Pan, Inches of Water	Calorific Value of Dry Fuel, B.T.U. per Lb.	Cinders Collected in Smoke Box, Pounds per Hour
	R. P. M. Cut-off Throttle	196	199	203	268 to 271	217	222	226	248	238
901	80-15-F	3.00	19.10	FULL	15.7	201.3	2.0	.2	15264	52
902	80-20-F	3.00	19.10	"	17.9	200.1	2.1	.1	15077	46
904	80-25-F	3.00	19.09	"	23.7	198.5	3.3	.7	15167	82
906	80-30-F	3.00	19.01	"	29.7	202.6	3.4	.5	15020	66
908	120-20-F	3.00	28.65	"	18.8	201.0	3.9	.7	15167	101
910	120-25-F	3.00	28.65	"	24.9	200.5	5.1	1.0	15167	236
912	120-30-F	2.50	28.65	"	31.7	202.7	4.9	.5	15057	110
913	160-15-F	3.00	38.20	"	16.7	198.0	3.1	.2	15264	98
914	160-20-F	3.00	38.20	"	20.2	202.9	3.7	.2	15264	194

TEST NUMBER	BOILER PERFORMANCE: Dry Fuel Fired per Hour, Pounds	Dry Fuel per Hour, Pounds per Sq. Ft. of Grate	Water Delivered to Boiler, Pounds per Hour	Equivalent Evaporation from and at 212° F., Pounds: Per Hour	Per Hour per Sq. Ft. of Fire Heating Sur.	Per Pound of Dry Fuel	Boiler Horse Power (34½ U. of E.)	Efficiency of Boiler, Based on Fuel	ENGINE PERFORMANCE: Pressure in Branch Pipe, Pounds per Sq. In.	Superheat in Branch Pipe, Degrees F.
	338	339	340	344	345	347	349	350	220	230
901	1665	30.00	14673	17806	7.68	10.69	516.0	67.65	198.3	0
902	1934	34.85	16075	19546	8.43	10.11	566.6	64.76	197.3	—
904	2177	39.23	18512	22466	9.69	10.32	651.1	68.71	192.8	4.00
906	2932	52.83	22536	27519	11.87	9.39	797.7	60.38	199.8	0
908	2455	44.24	20135	24434	10.54	9.95	708.2	63.36	197.7	4.20
910	3333	60.04	23334	28330	12.21	8.50	821.2	54.13	197.5	12.08
912	3988	71.86	27711	33792	14.68	8.47	979.4	54.32	197.8	12.43
913	2729	49.17	20759	25259	10.89	9.26	732.1	58.39	195.0	9.60
914	2998	54.01	22040	26851	11.58	8.96	778.3	56.68	198.2	11.72

TEST NUMBER	ENGINE PERFORMANCE: Dry Steam to Engines, Pounds per Hour	Indicated Horse Power	Dry Fuel per Indicated Horse Power Hour, Pounds	Dry Steam per Indicated Horse Power Hour, Pounds	LOCOMOTIVE PERFORMANCE: Drawbar Pull, Pounds	Dynamometer or Drawbar Horse Power	Dry Fuel per Dynamom. Horse Power Hour, Pounds	Dry Steam per Dynamom. Horse Power Hour, Pounds	Machine Efficiency of Locomotive, Per Cent.	Thermal Efficiency of Locomotive, per Cent., (Based on Fuel)
	214	379	380	381	265	383	384	385	398	399
901	14082	419.8	3.97	33.54	6427	327.3	5.09	43.02	77.96	3.28
902	15397	477.2	4.05	32.27	7653	389.8	4.96	39.50	81.68	3.40
904	17945	585.6	3.72	30.65	9810	499.6	4.36	35.92	85.35	3.85
906	21790	727.9	4.03	29.94	12475	632.3	4.64	34.46	86.87	3.65
908	19552	687.9	3.57	28.81	7280	556.2	4.42	35.16	80.89	3.79
910	22719	851.1	3.92	26.70	9438	721.1	4.62	31.51	84.71	3.63
912	26658	1015.4	3.93	26.63	11785	900.8	4.43	29.59	88.71	3.82
913	20034	748.8	3.64	26.75	5578	568.2	4.80	35.26	75.88	3.47
914	20948	826.8	3.63	25.34	6838	665.9	4.50	31.46	80.54	3.71

Four-Cylinder Compound Locomotives—Table 4, Test of Simple Locomotive No. 5266.

TEST NUMBER	RUNNING CONDITIONS: Test Designation	Duration of Test, Hours	Miles per Hour	Throttle Opening, Full or Partial	Actual Cut-off Per Cent., H. P. Cylinders	BOILER PERFORMANCE: Pressure in Boiler, Lbs. per Sq. Inch	Draft in Smoke Box, Inches of Water	Draft in Ash Pan, Inches of Water	Calorific Value of Dry Fuel, B.T.U. per Lb.	Cinders Collected in Smoke Box, Pounds per Hour
	R. P. M. Cut-off Throttle	196	199	203	268 to 271	217	222	226	248	238
1131	80-15-F	.75	18.61	FULL	14.3	205.4				
1116	80-20-F	3.00	18.61	"	21.3	203.2				
1125	80-30-F	.50	18.56	"	28.3	204.9				
1130	120-15-F	.75	27.91	"	14.5	203.5				
1128	120-20-F	.75	27.87	"	22.8	204.5				
1122	120-30-F	1.83	27.91	"	30.2	203.8				
1129	160-15-F	.50	37.24	"	14.8	203.6				
1127	160-20-F	.50	37.19	"	22.3	204.3				
1124	160-30-F	.50	37.24	"	29.5	204.4				
1132	160-30-F	.50	37.22	"	31.7	201.9				

TEST NUMBER	BOILER PERFORMANCE: Dry Fuel Fired per Hour, Pounds	Dry Fuel per Hour, Pounds per Sq. Ft. of Grate	Water Delivered to Boiler, Pounds per Hour	Equivalent Evaporation from and at 212° F., Pounds: Per Hour	Per Hour per Sq. Ft. of Fire Heating Sur.	Per Pound of Dry Fuel	Boiler Horse Power (34½ U. of E.)	Efficiency of Boiler, Based on Fuel	ENGINE PERFORMANCE: Pressure in Branch Pipe, Pounds per Sq. In.	Superheat in Branch Pipe, Degrees F.
	338	339	340	344	345	347	349	350	220	230
1131	—									
1116	1729									
1125	—									
1130	—									
1128	—									
1122	3013									
1129	—									
1127	—									
1124	—									
1132	—									

TEST NUMBER	ENGINE PERFORMANCE: Dry Steam to Engines, Pounds per Hour	Indicated Horse Power	Dry Fuel per Indicated Horse Power Hour, Pounds	Dry Steam per Indicated Horse Power Hour, Pounds	LOCOMOTIVE PERFORMANCE: Drawbar Pull, Pounds	Dynamometer or Drawbar Horse Power	Dry Fuel per Dynamom. Horse Power Hour, Pounds	Dry Steam per Dynamom. Horse Power Hour, Pounds	Machine Efficiency of Locomotive, Per Cent.	Thermal Efficiency of Locomotive, per Cent., (Based on Fuel)
	214	379	380	381	265	383	384	385	398	399
1131	11604	401.8	—	28.88	6912	343.0	—	33.83	85.36	—
1116	14814	527.8	3.28	28.07	9160	454.5	3.80	32.60	86.11	4.72
1125	17357	653.4	—	26.56	11427	565.6	—	30.69	86.56	—
1130	15785	617.3	—	25.57	6732	501.1	—	31.50	81.18	—
1128	20034	796.2	—	25.60	8992	668.2	—	29.98	83.92	—
1122	25555	977.7	3.08	26.14	11697	870.7	3.46	29.35	89.06	5.18
1129	18904	775.7	—	24.37	5909	586.8	—	32.22	75.65	—
1127	23512	993.6	—	23.66	8207	814.1	—	28.88	81.93	—
1124	29233	1199.5	—	24.37	10515	1044.2	—	28.00	87.05	—
1132	28520	1196.8	—	23.87	10114	1003.8	—	28.46	83.87	—

Four-Cylinder Compound Locomotives—Table 6, Test of Simple Locomotive No. 3162.

TEST NUMBER	RUNNING CONDITIONS: Test Designation	Duration of Test, Hours	Miles per Hour	Throttle Opening, Full or Partial	Actual Cut-off Per Cent., H. P. Cylinders	BOILER PERFORMANCE: Pressure in Boiler, Lbs. per Sq. Inch	Draft in Smoke Box, Inches of Water	Draft in Ash Pan, Inches of Water	Calorific Value of Dry Fuel, B.T.U. per Lb.	Cinders Collected in Smoke Box, Pounds per Hour
	R. P. M. Cut-off Throttle	196	199	203	268 to 271	217	222	226	248	238
916	160-25-F	2.50	38.20	FULL	24.9	200.0	5.2	.3	15264	302
917	160-27-F	3.00	38.20	"	27.7	188.4	7.7	.3	15167	492
918	160-30-F	1.00	38.20	"	31.5	186.1	8.9	1.3	15167	987
920	200-20-F	2.50	47.75	"	19.5	202.0	5.0	.2	15264	284
922	200-25-F	1.20	47.75	"	25.5	202.1	6.0	.3	15057	316
923	240-15-F	1.50	57.30	"	19.0	196.4	5.6	.2	15020	508
924	240-20-F	1.00	57.30	"	21.6	197.5	5.4	.3	15020	514
927	280-15-F	1.00	66.85	"	19.9	194.4	5.6	.2	15020	584
929	320-15-F	—	76.08	"	21.4	—	—	—	—	—

TEST NUMBER	BOILER PERFORMANCE: Dry Fuel Fired per Hour, Pounds	Dry Fuel per Hour, Pounds per Sq. Ft. of Grate	Water Delivered to Boiler, Pounds per Hour	Equivalent Evaporation from and at 212° F., Pounds: Per Hour	Per Hour per Sq. Ft. of Fire Heating Sur.	Per Pound of Dry Fuel	Boiler Horse Power (34½ U. of E.)	Efficiency of Boiler, Based on Fuel	ENGINE PERFORMANCE: Pressure in Branch Pipe, Pounds per Sq. In.	Superheat in Branch Pipe, Degrees F.
	338	339	340	344	345	347	349	350	220	230
916	4221	76.05	26436	32846	13.90	7.64	947.1	48.34	195.0	18.57
917	4802	86.53	28670	34793	15.00	7.25	1008.5	46.17	185.6	35.51
918	5561	100.58	30721	37170	16.03	6.66	1077.4	42.41	181.8	38.38
920	3694	66.86	26113	31841	13.73	8.62	922.9	54.52	197.4	17.16
922	4983	89.78	30300	36981	15.94	7.42	1071.9	47.50	197.1	22.23
923	5080	91.93	27365	33383	14.39	6.57	967.6	42.25	194.2	15.93
924	6101	109.93	28670	35014	15.10	5.74	1014.9	36.91	195.1	16.29
927	5012	90.31	28800	35240	15.19	7.03	1021.4	45.20	191.7	14.73
929	—	—	—	—	—	—	—	—	—	—

TEST NUMBER	ENGINE PERFORMANCE: Dry Steam to Engines, Pounds per Hour	Indicated Horse Power	Dry Fuel per Indicated Horse Power Hour, Pounds	Dry Steam per Indicated Horse Power Hour, Pounds	LOCOMOTIVE PERFORMANCE: Drawbar Pull, Pounds	Dynamometer or Drawbar Horse Power	Dry Fuel per Dynamom. Horse Power Hour, Pounds	Dry Steam per Dynamom. Horse Power Hour, Pounds	Machine Efficiency of Locomotive, Per Cent.	Thermal Efficiency of Locomotive, per Cent., (Based on Fuel)
	214	379	380	381	265	383	384	385	398	399
916	25536	1011.6	4.17	25.23	8155	830.7	5.08	30.73	82.11	3.28
917	27962	1085.0	4.55	25.80	8737	892.1	5.38	31.34	84.56	3.18
918	30060	1133.4	4.92	26.46	8571	975.0	5.72	30.83	86.02	2.93
920	25299	1018.6	3.63	24.83	6199	785.4	4.68	32.04	77.49	3.56
922	29176	1223.7	4.07	23.84	7701	980.6	5.08	29.75	80.13	3.33
923	26698	1085.4	4.68	24.60	4940	880.7	5.77	30.31	81.14	2.94
924	28375	1164.5	5.24	24.37	5908	902.8	6.76	31.43	77.53	2.51
927	28057	1178.4	4.25	23.81	4752	847.2	5.92	33.12	71.89	2.86
929	—	1281.3	—	—	—	—	—	—	—	—

Four-Cylinder Compound Locomotives—Table 5, Test of Simple Locomotive No. 5266.

TEST NUMBER	RUNNING CONDITIONS: Test Designation	Duration of Test, Hours	Miles per Hour	Throttle Opening, Full or Partial	Actual Cut-off Per Cent., H. P. Cylinders	BOILER PERFORMANCE: Pressure in Boiler, Lbs. per Sq. Inch	Draft in Smoke Box, Inches of Water	Draft in Ash Pan, Inches of Water	Calorific Value of Dry Fuel, B.T.U. per Lb.	Cinders Collected in Smoke Box, Pounds per Hour
	R. P. M. Cut-off Throttle	196	199	203	268 to 271	217	222	226	248	238
1133	160-30-F	.50	37.22	FULL	32.0	202.4				
1120	160-32-F	.50	37.19	"	36.8	204.3				
1126	200-20-F	.50	46.45	"	24.7	203.3				
1117	200-30-F	.58	46.52	"	33.4	203.1				
1123	200-30-F	1.00	46.29	"	32.3	186.7				
1118	200-32-F	—	46.48	"	37.8	198.5				
1121	200-32-F	—	46.52	"	36.2	191.0				
1119	240-15-F	—	55.83	"	20.4	203.5				

TEST NUMBER	BOILER PERFORMANCE: Dry Fuel Fired per Hour, Pounds	Dry Fuel per Hour, Pounds per Sq. Ft. of Grate	Water Delivered to Boiler, Pounds per Hour	Equivalent Evaporation from and at 212° F., Pounds: Per Hour	Per Hour per Sq. Ft. of Fire Heating Sur.	Per Pound of Dry Fuel	Boiler Horse Power (34½ U. of E.)	Efficiency of Boiler, Based on Fuel	ENGINE PERFORMANCE: Pressure in Branch Pipe, Pounds per Sq. In.	Superheat in Branch Pipe, Degrees F.
	338	339	340	344	345	347	349	350	220	230
1133									—	—
1120									200.8	0
1126									—	—
1117									198.8	0
1123									—	—
1118									—	—
1121									—	—
1119									—	—

TEST NUMBER	ENGINE PERFORMANCE: Dry Steam to Engines, Pounds per Hour	Indicated Horse Power	Dry Fuel per Indicated Horse Power Hour, Pounds	Dry Steam per Indicated Horse Power Hour, Pounds	LOCOMOTIVE PERFORMANCE: Drawbar Pull, Pounds	Dynamometer or Drawbar Horse Power	Dry Fuel per Dynamom. Horse Power Hour, Pounds	Dry Steam per Dynamom. Horse Power Hour, Pounds	Machine Efficiency of Locomotive, Per Cent.	Thermal Efficiency of Locomotive, per Cent., (Based on Fuel)
	214	379	380	381	265	383	384	385	398	399
1133	29443	1194.1	—	24.66	10071	999.5	—	29.46	83.70	—
1120	33103	1323.4	—	25.01	11674	1157.9	—	28.59	87.49	—
1126	28255	1191.1	—	23.72	7489	927.7	—	30.46	77.89	—
1117	34777	1413.9	—	24.60	8700	1079.3	—	32.22	76.33	—
1123	31957	1300.7	4.31	24.57	8460	1044.3	5.37	30.60	80.29	3.34
1118	—	1497.4	—	—	—	—	—	—	—	—
1121	—	1464.9	—	—	—	—	—	—	—	—
1119	—	1092.0	—	—	—	—	—	—	—	—

Four-Cylinder Compound Locomotives—Table 7, Test of Simple Locomotive No. 3162.

Balancing.

In the Pennsylvania Railroad report of the St. Louis tests there are shown diagrams which illustrate the perfection of balance of the locomotives, both vertically and horizontally,

and similar results are shown in the report for locomotive No. 5266.

It was made clear from the tests of the 4-cylinder compounds, that great care is necessary in the design of the weight and location of the counterbalance in this type of locomotive, in order to realize all of the advantages that are possible from this type.

Since the St. Louis tests, however, the method of counterbalancing balanced compounds is much better understood, and it is doubtful if a simple locomotive can be as satisfactorily counterbalanced. From the tests recently made on the simple locomotive, it may be possible to much more effectually balance a simple locomotive than has generally been thought possible.

Locomotive No. 5266 was not observed to leave the rail at speeds as high as 320 revolutions per minute, or 76 miles per hour, and its critical speed, or the speed where severe fore and aft vibration began, was as high as 200 revolutions per minute, or 48 miles per hour.

The method used in balancing locomotive No. 5266 was to place in the driving wheels weights equivalent to all of the revolving and two-thirds of the reciprocating weights.

By actual weighing of these balance weights in the wheels, the right main wheel was found to have 17 pounds too much;

TABLE No. 1.

SHOWING GENERAL DIMENSIONS OF LOCOMOTIVES.

Locomotive Number.	535	3000	5266	3162
Railroad Company....	A. T. & S. F.	N.Y.C.&H.R.	P. R. R.	P. R. R
Simple or Compound .	Compound.	Compound.	Simple.	Simple.
Total weight in working order, lbs	201,500	200,000	184,167	184,933
Weight on drivers, working order, lbs..	99,200	110,000	110,001	121,867
Cylinders, diameter and stroke, inches.	15x25x26	15½x26x26	20½ x 26	20½ x 26
Diameter of driving wheels, inches	79	79	80	80
Firebox heating surface, square feet ...	220.3	202.83	156.86	162.61
Heating surface of tubes (water side), square feet........	3016.71	3255.27	2471.04	2483.91
Total heating surface (water side of tubes), square feet	3237.01	3458.1	2627.90	2646.52
Total heating surface (fire side of tubes), square feet	2902.05	3051.19	2319.26	2336.03
Grate area, square feet	48.36	49.90	55.5	55.0
Boiler pressure, lbs. per square inch	220	220	205	205
Valves, type...... ...	Piston.	Piston.	Slide.	Piston.
Valves gear, type	Stephenson.	Stephenson.	Stephenson.	Walschaerts.
Firebox, type........	Wagon Top, Wide.	Wagon Top, Wide.	Belpaire, Wide.	Belpaire, Wide.
Number of tubes.....	273	390	315	315
Outside diameter of tubes, inches	2¼	2	2	2
Length of tubes, inches	225.14	191.29	180	180

the left main wheel 20 pounds too much; the right and left front wheels were found to have, each, 2.6 pounds too much, all these weights being at the crank pin radius.

Service Data.

In regard to the cost of maintenance and the cost of fuel, as actually developed in road trials, or in regular road service, your committee has been unable to secure sufficient data to present with any assurance of covering the ground in a satisfactory way.

One of the difficulties is probably due to the fact that railroads are not keeping the cost of fuel and repairs in a way which can be compared directly.

Furthermore, the balanced compound locomotives have been in service for but a few years, and probably not long enough to determine satisfactorily the cost of maintenance, as compared with the simple locomotives.

In an effort to secure this information, however, your committee sent statements covering the information desired to the heads of the mechanical departments of fifteen roads. These were selected as they had in service both compound and simple locomotives of the same types. Eight replies were received up to the time of preparing this report, of which five gave information more or less complete.

The cost per 100 miles for all repairs (a) boiler and (b) machinery was given in all cases but one. It varies from $1.44 to $10.10 for simple locomotives, and from $2.60 to $13.40 for compounds. On one road the cost given for one simple locomotive is 57 per cent greater than the cost of the other, these being the only two included. For two compounds on the same road, one costs 70 per cent more for repairs than the other. Even averaging these would be unfair as forming a basis for conclusions.

Another road shows two simple locomotives with superheater compared with two compounds without, all four being of about the same weight and capacity. The cost per 100 miles averaged is $1.49 for the simple and $2.60 for the compounds. These figures must include only a portion of the costs and can not be considered as comparative.

Conclusions.

It has been shown that in the foregoing that with the use of balanced compound locomotives a very considerable saving in fuel and water for the same work done, may be accomplished. It is equally clear from the discussion that the capacity of the locomotive with compound cylinders is increased.

The figures which have been given for fuel and water are, it is true, obtained on the locomotive testing plant where the conditions of running are uniform, and in road service the relative economy will undoubtedly be somewhat changed.

The testing plant does not give any figures on the cost of maintenance, and your committee, being unable to secure any data on this subject, is unable to give conclusions in regard to the ultimate economy.

Your committee, however, is impressed with the possible saving in regular service of balanced compound locomotives, and this would undoubtedly be realized with other types of compounds, but as the results in actual service are those which must finally be depended upon for ultimate economy, your committee would recommend to the members of the association a careful record of performance, in order to determine how far the economy in fuel and water can be realized, when all factors are considered.

The analysis already given and prepared for the purpose of determining the question of costs of maintenance, as well as the comparative cost of fuel, apparently covers the points involved sufficiently, but as stated, the committee could not secure this data covering a sufficient number of compound and simple locomotives to draw definite conclusions.

Some action of the association, which will secure the coöperation of railroads in preparing information on this basis for the next convention, might produce valuable comparisons. It is necessary to have these records of performance covering the period from the time the locomotive was built and placed in service up to and including the most recent data concerning its performance.

This would involve probably considerable work in going over old records, but if some satisfactory conclusions could be reached in regard to this matter on the basis of ultimate economy, a decided step forward would be gained in railroad operation.

Railroad Conventions for 1908.

August 18.—International Master Blacksmiths' Association at Cincinnati, O. Secretary, A. L. Woodworth, Cincinnati Hamilton & Dayton, Lima, O.

September 8.—Master Car and Locomotive Painters' Association of the United States and Canada at Atlantic City, N. J. Secretary, A. P. Dane, Boston & Maine, Boston, Mass.

September 8.—Railway Signal Association at Great Northern hotel, Chicago, Ill. (Regular meeting.) Secretary, C. C. Rosenberg, 12 North Linden street, Bethlehem, Pa.

September 15.—Individual Car Owners' Association at the Auditorium hotel, Chicago, Ill. Secretary, Robert J. Bailey, Pittsburg, Pa.

October 13.—Railway Signal Association at New Willard hotel, Washington, D. C. (Annual meeting.) Secretary, C. C. Rosenberg, 12 North Linden street, Bethlehem, Pa.

October 14.—Central Association of Railroad Officers at Peoria, Ill. Secretary, O. G. Fetter, 11 Carew building, Concinnati, O.

October 20.—Association of Railway Superintendents of Bridges and Buildings at Washington, D. C. Secretary, S. F. Patterson, Concord, N. H.

November 10.—Roadmasters' and Maintenance of Way Association at Milwaukee, Wis. Secretary, Walter E. Emery, Chicago & Alton, Kansas City, Mo.

SIZE AND CAPACITY OF SAFETY VALVES FOR USE ON LOCOMOTIVE BOILERS.*

No uniform practice seems to have prevailed in the past in proportioning safety valves to the work they are to perform. The locomotive builders follow specifications of the railroad companies, and it seems to have been the practice of the railroad companies to base their specifications on what has been done before on similar locomotives. The various railroad companies have fallen into the practice of specifying so many 2½-inch, 3-inch, 3½-inch or 4-inch valves, which, when reduced to exact language, does not mean anything definite. Obviously, two 3-inch valves having a sustained lift of ⅛-inch have a greater capacity for the discharge of steam than eight 3-inch valves having a sustained lift of 1-32 inch each. The committee does not wish to convey the idea that the two 3-inch valves having a sustained lift of ⅛-inch are better for the boiler than eight 3-inch valves having each a sustained lift of 1-32 inch, but merely wish to point out the errors that may arise from the practice of specifying so many valves regardless of the sustained lift.

The committee regrets very much that during the past year it was not able to conduct tests and obtain experimental data, which would no doubt prove of value in the solution of this problem. However, we deem it within our province to outline briefly along what lines any future investigations should be conducted.

We already have information as to the maximum evaporation of locomotives from the tests at St. Louis in 1904, but the committee feels that the safety valves would never be called upon to relieve this amount from the fact that the combustion in the firebox is stimulated by the exhaust, and that this exhaust is caused from the use of the steam in the cylinders. So that, at a time of greatest evaporation, the steam is being used approximately as fast as it is generated. Hence, it remains for the investigators to determine what shall be deemed the proper amount of relief in safety valves. Then, too, the lift of valves of various sizes at the different pressures must necessarily be determined, as also the effect of this lift on the life of the valve seats and the tendency the lift of the valves may have to raise the water in the boiler.

It is no less important that some data be collected on open and muffled valves, and in this connection, considering the tendency of the muffler to retard the flow of steam through the valve, it is of importance to review the work of Mr. Brownlee on the flow of steam through an orifice, which is contained in a "Report on Safety Valves" in the transactions of the Institution of Engineers and Shipbuilders in Scotland, Vol. XVIII, 1874-75, page 13. In this report Mr. Brownlee has compiled some data on the rates of discharge under a constant internal pressure, into various external pressures, upon which D. K. Clark, in his work on the steam engine, bases the following statements: "The flow of steam of a greater pressure into a receiver of a less pressure increases as the difference of pressure is increased, until the external pressure becomes only 58 per cent. of the absolute pressure in the boiler. The flow of steam is neither increased nor diminished by the fall of the external pressure below 58 per cent, or about four-sevenths of the inside pressure, even to the extent of a perfect vacuum. In flowing through a nozzle of the best form, the steam expands to the external pressure, and to the volume due to this pressure, so long as it is not less than 58 per cent of the internal pressure. For an external pressure of 58 per cent and for lower percentages, the ratio of expansion is 1 to 1.624."

From the foregoing, one is led to believe that the muffler produces no appreciable retarding effect on the safety valve. The committee feels that this should be verified in present practice.

It is essential that the amount of evaporation that the safety valves should relieve be determined. This can best be determined by applying two safety valves of known diameters and lift, which, according to the empirical formula, are known to be a little small. A third valve, of a larger diameter and set to pop at a somewhat higher pressure than the smaller valves, should be applied as a means of protection. If at any time during the test the two small valves go into action and the boiler pressure rises above the popping point, it would be reasonable to assume that the valves were of insufficient capacity. Another trial with valves of a larger diameter would no doubt prove of sufficient capacity. By changes in this manner it would be possible to apply two valves of sufficient capacity, and the diameter, lift, and form of valve being known, it would be a simple matter to obtain the amount of evaporation that the valves were called upon to relieve on the particular type of locomotive in question. It is important in this connection that the observation of pressures be very accurate, and the committee would suggest that a pressure-recording gage be attached to the boiler to serve as a check on the observer. Suitable gages for this work are now on the market. Perhaps the most reliable method of determining the lift of the valves would be to attach a rod to the top of the valve stem. This rod could be connected to a lift-recording gage and also to a lift-recording mechanism, operated by a small motor, which, while recording the lift on the card, would also record the time element. This mechanism would give an accurate check on the gage observations. It is understood of course that the lift measurements be made in the shop.

The replies from some twenty railroads to letters of inquiry show that the safety valves now in use are of sufficient capacity, and on these reports the committee has based the calculations that are to follow. The records from twelve important roads show that the lift of the valves varies from 1-32 inch to 1-10 inch.

Taking the mean effective area of opening in square inches per 500 square feet of heating surface, based on existing average practice of twelve railroads, we have developed the following empirical formula:

$$A = 0.10266 \text{ H. S.} \div \text{P.}$$

where A equals the effective area of opening of the valve in square inches, H. S. equals the heating surface of boiler in square feet, and P equals the absolute pressure (gage pressure plus 15 pounds). The formula is based on an evaporation of 5.28 pounds of water per square foot of heating surface per hour, and we recommend it for use in the application of safety valves until such time as it is shown to be in error or, upon future investigation, a better one shall have been devised.

The valves of nine prominent valve manufacturers show a lift ranging from 0.03 inch up to 0.15 inch; taking an average of these lifts (0.087 inch) and working out the values for typical modern switching, freight and passenger locomotives, we give the following tabulation illustrating the application of the empirical formula:

Type of Locomotive.	Service.	Heating Surface. Sq. Ft.	Gage Pressure.	No. and Size of Valves.
Pacific	Passenger.	3500	200	three—3½-inch
Consolidation ..	Freight....	3200	200	three—3½ "
6-wheel switch.	Yard......	1900	200	two —3½ "

The number and size of safety valves for the Pacific and Consolidation locomotives are the same. This is so because the committee deems it advisable and would recommend that the railway companies adopt one standard size of safety valve for all their locomotives, and not have, say, two 3-inch and one 3½-inch valve on the same locomotive. We feel that the adoption by railroads of one size of safety valve for all locomotives will bring about a uniformity that is much to be desired. The valves shown in the tabulation are assumed to have forty-five-degree seats.

In all these deductions one must bear in mind that the committee has assumed a rate of evaporation based on the capacity of discharge of the safety valves now in use, and since a vast majority of the railroads are experiencing no difficulty with safety valves this seems to be a reasonable assumption.

Minority Report.

BY JAMES MILLIKEN.

The writer has declined to sign the report of the committee appointed to collect data on the sizes and capacity of safety valves and to suggest methods for carrying out tests to determine the data in connection therewith, for the following reasons:

(1) Because there is given a definite recommendation founded on an empirical formula that appeals to us as not having been proved as dependable.

(2) Because a definite size of safety valves is recommended for given capacity boilers without regard to location, when the location of safety valves, to give desired results, is just as important as the size of the valves themselves.

(3) Because of the further recommendation to use but one size of valves regardless of the number that may be required on very large boilers.

(4) Because, while a valve of a given diameter is suggested, no maximum lift, or free discharge, is recommended.

The committee has found this a large subject, and while a very important one, it is surprising what little valuable data is available; there are numbers of formulæ, generally quite old, and the majority evidently relate to stationary

*Abstract of a report presented at the annual convention of the American Railway Master Mechanics' Association at Atlantic City, N. J., June, 1908, by F. M. Gilbert, G. W. Wildin and J. H. Manning, a majority of the committee.

practice, and you will coincide that there is a vast difference in the requirements for safety valves for stationary boilers and modern high pressure locomotive boilers of to-day. Stationary boilers usually have large steam spaces, where valves can be conveniently and properly located, and it is seldom that the entire volume of steam being generated is held in check suddenly. With the locomotive the boiler is urged to its utmost capacity; the throttle instantly closed; the draft, caused by the speed of the engine, only partially stopped and often induced by the use of the blower to prevent the emission of smoke; hence the greater necessity of the use of correct size and properly located safety valves. Quite a number of these formulæ are worked out on a grate area basis, which is eminently wrong, because the effectiveness of the grate area is dependent on the kind of fuel used, varying from anthracite to high grade, gas-bituminous, and even to other fuels, such as crude oils and petroleums. Other authorities use the heating surface of the boiler as a constant, and with this as a basis the evaporative efficiency of the boilers must be considered, and it is here that we feel we should be careful of our data.

The committee has used an evaporation of 5.28 pounds of water per square foot of heating surface, and tests of recently constructed boilers, as brought out by the test at St. Louis, have given over 12 pounds, or an increase of over 100 per cent.

I think that you will agree with me that the proper location of safety valves is just as important as their size; there are numerous examples of valves located on shells of boilers, attached to contracted steam spaces, or that have been located on pipe connections, that have resulted in entrained water and fluctuation of pressure in contracted steam spaces that has resulted in destroying the valves and failure to relieve the boilers; while the same sized valves, when properly relocated, have worked satisfactorily.

In connection with the third reason, the writer objects to the use of more than two safety valves, when they can be had of sufficient capacity to relieve the boiler, believing the cost and care necessitated in maintaining them will more than offset the advantage of maintaining but one size. Each valve should be of sufficient capacity to generally relieve the boiler under ordinary working conditions; the second valve should be provided to take care of extraordinary or unusual conditions and should only come into play sufficiently often to insure its being kept in working condition. In other words, we should use two safety valves for the same reason that we use two injectors, one to supply the boiler ordinarily, the second as a relief in case of failure of the first or upon extraordinary momentary duty being placed on the boiler.

The writer feels, in view of the great importance of this subject and the small amount of absolutely accurate information that the committee has been able to gather this year, that the committee should be continued; that its scope should be increased to cover the subject of safety valves generally, muffled as well as open valves, and particularly to make recommendations, in addition to the capacity of the safety valves, for their location; that they be authorized to conduct tests to determine if any of the rules that are now in force are correct and if not to formulate such rules as will provide us all with good working basis. While the diameter by which safety valves are now usually ordered is quite important, a more important fact is the real area of outlet, and the size of this outlet will be governed not only by the foregone conclusions, but also by the pressure that the boilers carry.

SUBJECTS.*

[The subjects for Noon-Hour Topical Discussions at the 1908 convention appear in their proper places in the daily programme.—Eds.]

Committee Reports for 1909.

1. The organization best suited to obtain economical results in maintenance of locomotives.

Le Grand Parish, H. D. Taylor, D. J. Redding, A Forsythe, S. J. Hungerford, H. W. Jacobs.

2. Driving pressure for firebox rivets and the advantage of avoiding seams in locomotive crown sheets.

W. F. Kiesel, J. H. Manning, W. A. Robb, H. H. Maxfield, G. Wagstaff.

3. Use of plug and ring gages for all important fits.

R. N. Durborow, A. Stewart, L. H. Turner, H. B. Ayres.

4. Ash pits and ash handling plants; the best and most efficient arrangement.

H. S. Hayward, W. Manchester, F. H. Clark, John Howard, H. M. Curry.

5. Rolled steel wheels.

A. S. Vogt, H. Bartlett, J. E. Muhlfeld, C. H. Quereau, G. W. Wildin.

6. Standard rules for testing boilers and staybolts.

J. T. Wallis, T. A. Foque, M. E. Wells, M. H. Wickhorst, W. C. A. Henry.

7. Standard limits governing the wear of locomotive tires, as concerns height and thickness of flange and depth of channeling.

E. D. Bronner, Robt. Quayle, R. K. Reading, C. E. Fuller, J. T. McGrath.

8. Advantages of water purification as a means of decreasing cost of locomotive repairs and reducing failures on the road.

W. C. Arp, H. Stillman, G. H. Emerson, R. D. Smith, E. B. Thompson.

9. Investigation as to the most desirable composition of material for locomotive driving wheel tires, and adoption of standard grades for various classes of service.

T. W. Demarest, W. R. McKeen, J. A. Carney, W. A. Nettleton, F. M. Whyte, C. B. Dudley.

Individual Papers for 1909.

1. Heat transference of tubes and plates.

Prof. Charles Edward Lucke, Columbia University.

2. Crane hooks; results of exhaustive experiments and recommendations as to design.

Prof. Walter Rautenstrauth, Columbia University.

BALL JOINT UNIONS.

The topical discussion before the Master Mechanics' Association, on June 24, on the subject: "Advisability of using ball joint unions for air and steam pipe connections on locomotives and tenders," was opened by C. B. Young (C. B. & Q.) as follows:

"Ball joints in the air and steam piping of locomotives are advisable both from a service and an economy standpoint. A joint with a flat gasket of rubber or composition containing rubber is liable to leak, owing to the vulcanization of the rubber when subjected to heat in steam pipes, or it becomes softened by the oil in air pipes and leaks soon develop through the joint. With ball joints made with metal against metal these troubles are entirely overcome. With a flat joint a gasket has to be kept in place while the coupling is being made, and occasionally this gasket doubles up or falls out without being noticed. In a difficult place one man cannot manage to hold a light, to see that the gasket is in place and make a coupling.

A ball joint does not produce these troubles; as there is no gasket to put in, it is more easily applied than a flat joint, and in case the piping is not perfectly in line, a ball joint can easily be put together when it would be exceedingly difficult to connect up a flat joint or to make it steam or air tight.

There are a number of ball joints on the market, several of which are satisfactory. These are of two styles; those with the brass seat loosely fitted, and consequently likely to be lost out, and those which have it pressed in and permanently secured. For joints which are seldom broken the former is satisfactory, but for joints which are frequently broken, a ball joint with permanent seat should be selected. One of the most troublesome joints on an engine is the flat gasket joint in the air pump discharge pipe next to the pump. Owing to the high temperature this gasket soon gives out. Something more than a year ago we fitted up some air pumps with ball joints at this point and have not had a leak or a case of repairs since the change was made.

A number of different designs of ball joints have been developed for connections between engine and tender in place of rubber hose for steam and air lines. Some of these have been found very satisfactory and economical. I have no hesitation in recommending the use of ball joints throughout in the piping system of engine and tenders.

T. H. Curtis (L. & N.): I want to support what Mr. Young has said in regard to metal joints. I think the time has gone by for any composition joint to be used in any union or coupling on locomotive tenders, and I hope to see the day when the manufacturers of those ball joints will endeavor to get together on a standard whereby we may have some interchangeability of at least the contour of the joint, and not make it necessary when one part is damaged to throw the whole joint away in order to get a new or a satisfactory coupling.

F. F. Gaines (Cent. of Ga.): I would like to ask Mr. Young whether he would recommend the ball joint having the two brass surfaces together or the one with the brass and iron.

Mr. Young: It seems to me that the ball joint with the brass seat—one brass seat, is sufficient and answers every purpose.

*Report presented at the annual convention of the American American Railway Master Mechanics' Association at Atlantic City, N. J., June, 1908, by a committee consisting of C. A. Seley, D. E. Crawford and L. R. Pomeroy.

ALLOY STEEL.

The topical discussion before the Master Mechanics' Association on June 22 on the subject: "Alloy steel; results from use in machine tools and special cutters," was opened by J. A. Carney (C. B. & Q.) as follows:

Alloy steel is commonly known as "high-speed" steel. Some five years ago a specification was made for certain lathes which gave the general dimensions of swing and length between centers and stipulated that they should cut 50 feet per minute with ⅛-inch feed and ¼-inch depth of cut in medium steel. These specifications were submitted to machine tool makers and without exception came the reply that such tools were not made. Today tools are turned out whose principal selling point is the fact that they will more than do the work specified five years ago. So much for the improvements in machine tools brought about by the introduction of alloy steel.

The ability to take heavy cuts at three to four times the speed used with tempering steel is an item of great merit, but to my mind the most valuable feature is the steel's ability to continue at work almost indefinitely without losing its cutting edge. The time taken removing tools which have lost their cutting edge and replacing them with dressed tools is dead loss; it curtails output and prevents maximum efficiency of a machine and is a source of annoyance to the machine operator.

Compared with tempering steel one-fourth of the number of tools of alloy steel are a more than ample stock because of their ability to stand up to the work. In one case 250 pounds of tempering steel was replaced with six pounds of alloy steel. The money spent on dressing tools is probably not one-tenth of what it would be if a similar output were undertaken with tempering steel.

The high cost has made it unprofitable to use alloy steel for heavy milling tools, reamers, cutters, etc.; and it is very generally the practice to use teeth of alloy steel inserted in a body of a material much cheaper and less liable to fracture. The results are good, a more even and efficient temper can be obtained on a small piece than on a large and bulky one, and there is no danger of spoiling the body. The milling cutter with inserted alloy steel teeth has brought the slab milling machine to its present state of high efficiency and on many operations it is more efficient than a planer.

Drills and reamers with special alloy steel inserted cutters have revolutionized many methods of finishing engine parts. Steel bushings 2½ inches and 3 inches in diameter bored from a solid rod can be made cheaper than by any other process. Cored steel castings that were formerly bored out on a lathe or boring mill can be reamed out on a drill press with a special cutter for one-fourth of the former cost. One reamer with alloy steel cutters will ream a hole increasing the diameter one-half inch in one cut where four cuts are necessary with tempering steel. In a shop which formerly spent $75 a month on repairs to reamers the cost has been reduced to less than $5 with high speed reamers.

It is needless to go into a long list of detailed operations; they are to be found in every shop, and if we are a little slow catching on some of our good friends in the machine-tool line will show us the error of our ways.

One of the most noticeable improvements on some classes of machines is the method of fastening the work, brought about entirely by the use of alloy steel. This is particularly true on the new designs of driving-wheel tire lathes.

Alloy steel is particularly valuable in finishing brass and a speed of from 200 to 375 feed a minute can be maintained. Sand in the casting does not so seriously affect the cutting edge as in tempering steel. These results are impossible with tempering steel.

The use of high speed steel for track work is of immense value. There is no shop or tool dresser with a section gang and the failure of a drill may mean the loss of a day's work. In a recent test on track drills a special make of tempered steel drilled 47 holes 15/16-inch diameter ⅝-inch deep and had to be redressed. A high speed steel drill at the same speed and feed drilled 308 holes and was in good condition.

Flue-beading tools, rivet sets, air-hammer chisels, etc., made of alloy steel do so much more work than tools made of temper steel that they are an economical proposition. Rivet sets should not be tempered. The heat of the rivet does the tempering.

Plates of alloy steel have been successfully brazed to pieces of common soft steel and used for finshing tools on tire turning.

It would be almost impossible to tabulate the improvements made and the costs reduced by alloy steel, but it can be summed up as follows: First, Heavier cuts at faster speed; second, Heavier and more powerful machine tools; third, Improved methods of fastening work; fourth, Use of inserted tooth cutters in place of single tools; fifth, It is difficult to say how much a reduction in cost of machine work can be attributed to alloy steel, but this fact is apparent: An increase in machinists' wages of about 35 per cent in the past six or seven years has not increased the labor cost of machine work, and in many cases the cost has been lessened by the use of alloy steel and machines designed for its use.

Mr. Henderson: The particular point in connection with the tool steel, as brought out in this paper, is the enormous increase in the size and capacity of machine. My attention was called to that two months ago by a test which was made by the William Sellers Company of a couple of wheel lathes which they had drilled for the M. K. & T. Railway. There were a number of new principles involved and brought out in connection with the use of this steel, and whereas a few years ago it used to require ten hours or one day to repair a pair of tires, in this test three pairs of tires were turned up in one hour, which is a pretty good showing. Of course, this was a combination of high speed steel and very heavy machine drill for the purpose of getting all there was out of it.

F. F. Gaines (Cent. of Ga.): Recently I have had a chance to try some high speed steel with vanadium content. The tools I tried were in connection with pneumatic tools, caulking, chipping chisels, things of that sort. It is simply wonderful the punishment you can put that steel through for that purpose. I am going, later, to experiment with it in machine tools to see if I can get as good results. I would like to hear if anyone has tried the high speed steel with the vanadium content in it.

H. H. Vaughan (Can. Pac.): The use of alloy steel has practically made a revolution in our machine shop practice in the last few years. That is a fact which I think no one will deny. Most of us will probably remember the convention of 1901 when the representatives of the Bethlehem steel company were exhibiting samples of chips such as none of us had ever seen before. Since that the use of alloy steels has come in until today they are, I suppose, used in practically every railroad shop as well as other manufacturing establishments. In getting records today of what can be done it is more a question of the class of machinery that our shops are equipped with than of the composition of the steel. Our experience has generally been that it is necessary to use a certain amount of caution against too much crowding with these high speed steels. We are liable to waste more money tearing tools of the older type to pieces than the increased output pays for. Perhaps from one point of view it would be better to tear them to pieces and replace them with others, but it is not always easy to get money from the management to replace tools that are only a few years old and which will give us pretty good service. In our selection of high speed steel we have found it advantageous to pay a good deal of attention to the strength of the steel. There appears to be a variation between the compositions of the steels offered by the various makers, although a majority of them seem to me to give fairly reasonable results. It is also difficult to pick between one steel and another on tests, but we do find that some steels are very much more friable than others and it is rather a hard thing to clean up a dollar or a dollar and a half high speed steel in a cut just because you are using a brittle steel. We found considerable advantage from making a series of tests, taking a number of different makes of high speed steels and selecting those which appeared to break the least or to be liable to fracture the least. Another thing which we have done, which I think is a good plan, is to limit the number of high speed steels we use to a certain quantity. Our standard is to use only three steels, and while we have, of course, had a good deal of difficulty in keeping down to that, we have done so for the last year or two simply to have everybody familiar with the standard grades of steel, and not handle ten or fifteen different kinds of tool steel through the tempering room. I would certainly concur with Mr. Carney as to the wonderful wear that these steels give us when properly handled and taken care of. Our wear with high speed steel is very small, considerably less than it used to be, I believe, with carbon tool steel in the older days, and on drills, especially with certain makes of high speed drills, we have found we could drill about a thousand feet of metal per inch of drill, which is certainly a wonderful record for a material that will drill at the speed which the high speed steel does. I feel that the steel people almost can take a rest at the present time. It is up to our equipment to catch up with the steels in many cases. Those of us who have the most modern tools can make good use of them; but in the older tools we are running up to the capacity of the steel, and it means a large expense in the future in tools and machinery to keep up with the present advance in alloy steel.

C. D. Young (Pa.): In answer to Mr. Gaines' question as to high speed steel that is in use with vanadium, I might

say that about a year and a half ago we started to try vanadium high speed steel and got excellent results from it. I think the steel that we got contained about 17 of vanadium, about 7 of chrome and about 8 of tungsten. So in this combination vanadium is the larger proportion. That steel is cited in Mr. Taylor's paper read before the American Society of Mechanical Engineers. I think Mr. Taylor thoroughly covered the high speed steel question up to the time that he wrote his paper. We have been using this steel now in cast iron, manganese steel, on high carbon steel and some on brass; but not on bronze. It has not given any service there. We have been able to turn out 15 pairs of driving wheels with vanadium tools without regrinding, and we have averaged about 11 pairs of wheels. These wheels were turned out on a 36-inch truck wheel lathe at an average time of about 40 minutes. Tools with vanadium steel have given very good service.

The President: The question was raised as to the extent to which vanadium had been used in tool steel. I can only tell you about one chisel, that is from actual experience. We had some trouble with transmission bars on a certain class of engine, and decided to order some with vanadium steel. We started in to machine them. Well, I guess they are busy at it yet in our shops. They arrived some months ago. They finally, in experimenting, took out a piece and made some excellent cold chisels from the vanadium steel. We took the matter up with the vanadium people and it was finally traced until they discovered that the steel was intended for tires instead of for transmission bars, and I can safely say that if that is the quality of steel that they are furnishing for tires we can expect extraordinary wear from them in the line of service.

R. P. C. Sanderson (Virginian): One point in connection with this matter of high speed steels in modern machine shop practice has been referred to only indirectly, and that is the system of shop methods of using it. To illustrate the point I wish to make, I will say that when the Taylor-White process steel was first exploited in this country at the time Mr. Vaughan referred to I visited the Bethlehem Steel Works with a view to going into the matter personally to see whether it would pay the company I was then working for to buy the rights and use it. They gave me every facility for going through the shop. I found that they had gone to work in the most thorough manner and figured up the actual capacity of every machine they had. They had calculated the strength of the spindles and arrived at the strength of their lathes and tools holders and so on, the strength of the gears in driving machines and they decided just what pressure would be borne at the point of the tool without paralyzing the machine. In some cases they had gone so far as to break the machines open to establish that pressure. Having done that they went through a careful series of experiments to show the power required to tear out the metal with properly formed tools at given speeds, depths of cut and feeds in different qualities of steel, nickel steel, high carbon and low carbon steel and wrought iron. Having done that, they tabulated the work that should be done in speeds that should be used for the different feeds and cuts of each machine in their shop. Then they did not leave it optional with the men at all as to how they should turn out the work, but they have speed bosses around the shop who check up the speeds actually used by the mechanics, and they followed it up so closely that they practically got the maximum possible output from each machine from each type. That was done in that shop, and I made up my mind that a large portion of the great advance they have made in machine shop practice was due to their thorough method of enforcing the maximum output of every machine and every man rather than the mere ability of the tool steel to stand the work; and we cannot get the results that we should unless the same pains is taken by the machine shop foreman and management to force the output of each machine up to the full capacity both of the machine and the tool steel. One thing won't bring results without the other.

J. F. Devoy (C. M. & St. P.): Much of this discussion seems to resolve itself in the amount of work that can be got out of a lathe or a machine of that kind, and particularly with reference to the wear of steel. I would like to mention one thing that to me appears more important than the getting out of the work. That is, that in turning tires of drivers, or a steel tire wheel, I have in many cases and on more than one railroad seen the operator pay absolutely no attention to what the size of his wheel was to be turned. I would much rather lose ten or fifteen or possibly twenty per cent., in the amount of work done, and on every pair of wheels see the witness mark, or a small portion of that tire that had not been turned away. I would prefer that last sixteenth of an inch in a tire for additional wear than I would to see a man rip a tire to pieces in say seven or eight revolutions on a driving wheel lathe. You will save much more money in the long run if you attempt to make your operator observe that point, and if he will in making the wheel each time try to observe that I believe you will save more than you will in any output.

Another point came to me very clearly in looking to the reason why we have cracked tires, especially in the winter time. It appeared to me that in turning the tires, especially where a heavy cut was made on the flange, that possibly the tool, notwithstanding the great power of the lathe, had, so to speak, laminated the steel, and that there was a slight fracture there. If any of you have examined tires as the first begin to break, especially in a cold country, you will see a slight crack on the outer edge of the flange of the tire, and following that up further with a microscopical examination it has appeared to me that a great deal of that has been caused in the driving wheel lathe. I am not at all opposed to a powerful machine; the more power it has the better, but I do particularly want to call attention to the fact of seeing that every operator should leave that witness mark on his steel tire.

George L. Fowler: I would like to corroborate what Mr. Devoy has just said in regard to the ripping-off of steel and the condition it is left in in exceedingly heavy cuts. Take a tire wheel with a cut of ⅜-inch to ½ speed, or ½-inch cut and 3 inches in speed, it leaves a surface with the metal very badly cracked and an examination of some of that work under a glass leads me to believe that those cracks extend down in for at least 1-16-inch in very many cases. I was called in a short time ago to offer a remedy for some troubles they were having with an electric car, and I found they were turning over steel wheels under exactly those conditions. I suggested that instead of finishing the wheel with that exceedingly heavy cut they finish it with a light cut, perhaps taking out a little more metal, but leaving the metal on the surface of the tread smooth and free from those cracks. The difficulty of cracked wheels and chipping in the flanges, entirely disappeared by that simple remedy of leaving the tread in good condition when it was put back in service.

Mr. Bentley: I think there is a great deal in what Mr. Devoy has said. I don't know whether he can get a witness mark on all of his wheels. He may be able to leave a witness mark on one tire; but I don't see how he could do it on all of them. I believe we leave our wheels altogether too rough, and I feel satisfied that there is an excessive wear after they are put under the engine. I think we ought to leave our wheel tire tread smoother than we have been doing. I don't altogether agree about the checks in the flanges. I have seen a number of cases where you get one tire of a pair entirely free from tracks, and the next one would be so badly checked that if it were not removed it would have broken. I have always claimed that the tire-maker was responsible for that condition, and not the brake on the engine or anything we did to the tires that would bring about that result.

Mr. Forsyth: I was interested in the last part of Mr. Carney's paper where he referred to the fact that the increase in the output due to high speed steel had about increased the offset in wages and that suggested to me a comparison in the efficiency of the tools—the efficiency of the men and the wages paid. When I was at Mr. Carney's shop, he pointed out to me a machinist who was earning nearly $200 a month on piece work. I remember the time when the mechanic of the Altoona shops was not earning half that money, and it occurred to me that there might be a possibility of the machinist getting a greater benefit from the use of high-speed tools, and things of that kind, than the railroads got. I notice the statement of the gentleman who repaired 15 pairs of tires turned in a day with one grinding. It must have been a very powerful boring mill that the company had bought at a big expense, and there was high speed steel there which was bought at a high price, and the machinist only had to turn that tool once for that fifteen tires.

Yet probably he was paid a pretty good price per piece. The thought I wanted to suggest is that it has not been observed that the cost of repairs of locomotives, even on a basis of the increased weight, has not been reduced very much, and yet if we were to get the maximum benefit—if all the expense for putting in heavy machine tools and electric motors is considered, and if all those things are so efficient and do so much more work than the old style work, why don't the railroads show a much larger reduction in cost of repairs? Although I am in favor of a machinist earning a fair day's wage possibly in many cases he is being very much overpaid, and that the reason you don't see it is, is because you are getting such an enormous efficiency out of those improved things.

T. H. Curtis (L. & N.): I listened to what was said about the cracking of tires, owing to the high duty steel.

I want to ask if climatic conditions don't enter into that. The L. & N. was the first one to use the heavy wheel lathes. We take all there is of first cut and finish it in the second. If a tire is worn deeply it doesn't make any difference. We have about 800 locomotives on an average for the last four years and we haven't broken a tire. I don't see what the tire lathe has got to do with the tire in the breaking of it. On the other hand, in turning M. C. B. 5 x 9 axles in 5½ x 10 double-headed axle lathes, I have seen the axle spring in the middle on the first cut by taking off the stock. It is finished on the second cut by a light cut. We have never had one of those axles break, nor to run hot through the journal being out of true. I have been watching that very closely. I only brought this up as a suggestion to meet what has been said about the improved work done by high duty steel.

Mr. Gaines: I want to confirm what Mr. Curtis has just said. I don't believe that the rapid work has anything to do with the development of flaws in the tires. I know one road that has been turning out its steel tired passenger coach wheels with a roughing cut, omitting entirely the use of the scraper. We find that these wheels after five miles' use are perfectly smooth.

Refering to what Mr. Forsyth had to say in regard to the company getting the benefit of the cost: I believe we are going to get that benefit. We are getting it now some, and I think we are going to get it more as we get into the use of the handling of high speed steel. I have recently installed one of those 42-inch heavy duty steel tired wheel lathes. We used to get out two pairs of wheels or two and a half a day with an old machine. We don't employ a regular machinist. We use what we call a handy man and we are getting out our wheels for about twenty cents a pair where we used to pay anywhere from 80 cents to a dollar.

Mr. Devoy: So far as my observation is concerned, climatic conditions absolutely govern all tire failures. As soon as the good weather comes you are absolutely through with your tire failures. I would like to ask the gentleman in the south if he ever had a tire failure, because I don't see how they could down in that section. I would like to ask if he has ever paid any particular attention to the making of wheels and as to whether he has made any figures as to that 1-16th inch he has saved in tire wear. It will pay him. I don't object in the slightest to the amount of work a man will do; but there is a point in which he can save money by not turning off the steel. If any of the gentlemen have had any tire failures, have they ever taken the pains to find out as to whether there were any cracks in the flange of the wheel; because invariably they do occur, and in taking the matter up with the steel people I have never heard them offer any remedy.

D. J. Redding (Lake Erie): I think we are all familiar with the use of high speed steel. I will have to admit that I never heard of the crack spoken of in the driving wheel. Possibly it is because we don't have any extreme cold weather.

Mr. Vaughan: I would like to say in regard to this cracking that we have had several cases of slight cracking in the flange and on engines we never had any turning except the first turning at the works. I won't oppose the idea that a heavy turning of the flange might start little cracks, but I am inclined to the idea that this damage wouldn't occur if the tire were perfect. If there is any defect in the tire, a heavy cut might distrub the metal and start a crack. I believe these cracks that start through the flange are entirely due to the bending of the flange. There is no question at all in my mind that climatic conditions have everything to do with it. All our tire troubles come in the winter time. As soon as the frost gets out of the track we don't have any tire troubles until the next winter. That is one of the troubles we have experienced with the very best grades of tire we can get,—a little crack starting through the top of the flange. I believe it is due to the bending backwards and forwards of the flange. I think tire troubles have increased under severe conditions on account of lack of stiffness in the centre; and while we are using a very much stiffer centre than most people we have still a little of it.

Mr. Curtis: I think I should answer the gentleman who asks if we have inspected our wheels. Our wheels are all inspected carefully and we leave a little black spot as a general rule on one of the wheels, and the wheels are all properly mated, workmanship first class. I recall the breaking of a tire on a 68-inch wheel on a hot summer day. The tire was 1¼ inches thick and had been run too long. It broke from the inside outward. That is the only one I recall in the last five years, and that was before we started to use the heavy duty tire steel.

The President: I think a good deal of attention should be given to what Mr. Vaughan has said in regard to the springing of the tire and wheel causing these flange cracks, and it is possible that it is caused sometimes by unequal shimming of the tires in setting them. For instance, if you do not shim the entire circumference of the wheel there are apt to be spaces left where springing will occur.

C. E. Chambers (Cent. of N. J.): I know of cases where the break in the tire certainly started through the flange. Many times I think the breakage starts through the springing of the wheel. There is no doubt in the next five years most of the railroads will overcome a large amount of these troubles, by coming to the conclusion that putting more money on a wheel is money well expended. I think while the steel centre proposition went into effect, most railroads had adopted the ordinary cast iron patterns.

Mr. Redding: The introduction of high speed steel started the practice of making records on boring mills. I never found yet in my experience eight driving wheels taken from under a consolidation locomotive where the centres all callipered alike. Where you bore them in such a hurry, and necessarily tried to bore them to one size, somebody has got to shim them when they are put on. I think they are broken as much from improper shimming as from any other cause. The men are not expert mechanics and don't realize the necessity of working to a 1-60 or 1-80-inch as our gauge calls for. The majority of men, in boring tires, don't know anything about an 1-80 inch. They use a rule marked in sixteenths. I am inclined to think that a little less speed might very often save the breaking of tires.

A. Lovell: The question has been raised here as to whether the full benefits of high speed steel were being realized or whether the extra cost of the machines and the benefits of the high speed steel were not being used up in paying the additional wages to the men operating them. I think that is a matter which will work itself out in time to the benefit of the railroad. I think possibly as yet it is not fully adjusted and it is a very important matter that when new and improved machines are introduced into any shop where piece work rates or any premium system is adopted, it is very essential that the piece work rate shall be adjusted to fit this new condition of things. The old condition should not prevail. Again, it is very important that care should be exercised in providing new and improved machines to get the greatest benefit from the high speed steel that these machines be only introduced in such places where their full benefit can be utilized. For instance, if we have in a large machine shop an old wheel lathe which will stand the work at a slow rate of speed, and perhaps the tool is valued at $2,000 it would be good economy if that tool could be utilized all the time, to pay $10,000 for a high speed extra heavy machine in which the parts might be turned at the speed which has been represented here—three pairs in an hour. On the other hand, if this $2,000 machine is located in a small shop where there are only a few tires to be turned, and the machine is not in operation more than half or one-third of the time, it would not be good economy to throw away that machine, and expend $10,000 to buy one of the high speed machines. It would be better economy to pay a little more time to the workman and do a little less work. I think these matters should be looked into carefully, and that eventually the full benefits of the improved steel will result to the benefit of the railroads.

THE SMOKE NUISANCE.

The topical discussion before the Master Mechanics' Association on the subject: "The smoke nuisance. What is the best method of preventing it?" On June 22, was opened by H. T. Bentley (C. & N. W.) as follows:

It is not necessary for me to tell you what smoke is, or to say how very disagreeable it can be for those who have to come in contact with it, or what damage it does. Its presence in quantities at the stack shows conclusively that combustion in firebox is imperfect, either by reason of poor design in the boiler, poor firing, or insufficient air admitted through the grates to furnish oxygen in large enough quantities for complete combustion.

I am not prepared to furnish any new specific for the complete cure of smoke troubles. There are many practical difficulties in the way of consuming smoke, particularly in locomotive service, but they are not always altogether insuperable; that is to say, under ordinary conditions, the amount of smoke emitted can be so small as not to be objectionable. The principle involved is that of mixing air with the combustible vapor and gases generated by the action of heat on the fuel so that by a proper supply of oxygen being furnished they may be made to burn with flame and become entirely converted into combustible and invisible vapors and gases.

Having a large number of locomotives working in and around the city of Chicago, where the smoke inspection bureau has a staff of very active inspectors always on the look out for violators of the smoke ordinance, we have tried

nearly every scheme that has been suggested, or that we could think of, having a man specially qualified to watch results.

When reporting on any particular device we have invariably been told that, "It is a good thing if engine is properly fired," which brings us back to the personal equation; it has been our experience that no device we could put on an engine would do much good if engine was improperly fired.

We do not believe that it is possible to entirely eliminate all of the smoke at all times from a locomotive burning bituminous coal, on account of the nature of the service; first working at full stroke, then at short cut off, and suddenly being shut off entirely on account of being stopped by a signal, just as enough coal has been put in firebox to take the train up a grade or out of the way of a quickly following train, but we do say, that by careful firing, more than anything else, and a close working understanding between engineer and fireman, the amount of smoke emitted need not be of such an amount as to be open to serious criticism.

We have used so-called smokeless coal with fairly good results, but it is not entirely free from smoke, and has given us trouble in other directions. Have also tried coke, which is free from black smoke, but the fumes emitted are very objectionable.

In concluding we believe the smoke nuisance can be reduced to a minimum by the following: Co-operation on part of engine crew, careful firing, the use of a brick arch, coal properly broken up, engine and grate area of sufficient capacity to do the work required without crowding, grate openings large enough to supply the proper amount of air.

A paper on "Fuel Economy" was next presented by W. C. Squire of Chicago, in which he discussed recent improvements in American and European locomotive practice for effecting improved combustion and smoke prevention. The paper is largely historical and the illustrations shown are of a diagrammatical nature. The general conclusion of the author is that with arches from 10 to 20 per cent improvement in coal consumption is possible, and that where cinders are also returned to the firebox there is opportunity for still further saving in fuel, and that not the least of the benefits derived from any and all of the various devices described is that of the elimination of smoke. He urged that careful study and consideration be given to the devices which can and do eliminate both cinders and smoke.

Mr. Bentley: Since writing this report I have read in some of the Chicago papers that several of the eastern and some of the western roads have some new scheme for entirely eliminating black smoke. I am very glad to hear of it, and I am going to get in touch with the roads mentioned so as to get a pointer, because we are very anxious to cut out black smoke if we can; and I want to get in touch with somebody that has a new remedy. They tell me that they are so well satisfied that they have photographers out on the road taking photographs to show how little smoke is emitted.

A. E. Manchester (C. M. & St. P.): The question of smoke prevention is one to which we must give serious consideration. We have been following this matter for a good many years and have in a measure been successful in preventing smoke, but all of our efforts and all of the appliances that we have used in connection with smoke prevention carry with them a large factor of assistance in the methods of the engineer and firemen to get proper results. I believe that the methods referred to in the paper, and numerous other methods that are designed for the same purpose, can do very much toward the prevention of smoke. Among the other things that are necessary for the prevention of smoke, so far as it is possible, coal of uniform quality, and coal prepared in about the same way, shall be delivered in a given district and to certain men, so that they may become familiar with the use of that particular coal. The emission of air and steam jets over the fire and good brick arch arrangements are also extremely necessary, and very strong blower arrangements are necessary. In addition to the city inspection that we are subjected to we have found it necessary, as explained by Mr. Bentley, to keep a man constantly in the field looking after the emission of smoke from engines, and we have to give that man a good deal of authority over the enginemen. When he comes to an engine and finds the smoke-preventing appliances in good order and the engine still emitting black smoke, he decides whether the engineer or the fireman is responsible for that condition, and he takes such action as is necessary, even up to a long suspension. I had the necessity of this very forcibly impressed upon me about a year ago. A gentleman with a blue suit and a big star on his breast walked into the office and served a warrant on me, and next morning I had to appear at the police court to answer to a charge of smoke emission by one of the locomotives of the company which I represent. My plea was that the man had been taken out of the service about three days before the warrant was signed and I was dismissed. But engineers and firemen are such a strong factor in any device that I have ever seen or heard of, that it is necessary they should give you all the assistance possible in order to get results.

F. F. Gaines (Central of Ga.): There was a paper read, I believe it was before the American Society of Mechanical Engineers at their Detroit meeting, at any rate published recently, in which quite an extensive investigation was made of the proper combustion of soft coal. The subject was very thoroughly gone into, and from experiments made and also from the government's report on the same matter, the indications are that if we want to burn soft coal without making smoke we must keep our gases at a high temperature until they are consumed. To do that in stationary practice a very great number of arches, baffle plates and things of that nature have been advocated, entirely different from the present stationary practice; and I believe they have got some very beneficial results along those lines. I have not tried the Wade-Nicholson arch referred to here, but that seems to be a little along those lines, that is, keeping the hot gases away from the colder sheets in contact with the water until thorough combustion takes place.

Peter H. Peck (C. & W. I.): I am in the same boat with Mr. Manchester. In Chicago it is all terminal, and we have a dozen or fifteen smoke inspectors all the time, and every time there is black smoke it is a hundred dollars per, and we are all paying attention to it and working on it. I have tried, I think, every kind of smoke device that ever was built. The last I tried was the one referred to in the paper, and that is in line with the last speaker. There is a brick arch that hangs down from the crown. I think the Northwestern has also experimented with it. That is the best I have tried yet, not only the best but the cheapest. To instal that in an engine the first time costs only about twelve dollars. After that it is about three dollars an arch, and the arches probably last, the top one about four months, and the bottom about two. I have tried arches in every conceivable way. Some side-sheets in my old boilers look like porous plasters. They have holes punched in all of them for combustion, but they are still there and they are still smoking.

Angus Sinclair: I have paid considerable attention in my time to smoke preventing. I have found out that between the years 1856 and 1872 there were 167 smoke-preventing devices patented in Great Britain alone, nearly every one of them being guaranteed to prevent smoke with the help of a good engineer and fireman. That was never neglected.

I find that all recent inventions for smoke prevention have been modifications of those inventions that have gone before. Anyone who is familiar with Holly's "Locomotive Engineering" or Clark's "Railway Machinery," can find out everything relating to smoke prevention that is likely to be known to-day. There is no question but that they prevented smoke fairly, but not entirely. My experience in the British Isles and on the continent of Europe is that the smoke that rose from the trains is just about as bad as it is on the lighter worked lines in this country. They have come to acknowledge that a certain amount of smoke is necessary. If it is very bad they get after the enginemen. I think that the locomotive departments in this country will have to settle down to the same thing, not forgetting to keep after the men who cause a bad nuisance from smoke.

I might say that among the great number of patented devices that were brought out in Great Britain none of them is in use today except the brick arch, which, by the way, was not a patented invention. The brick arch was first applied by Briggs of the Boston & Providence Railroad and it was adopted very promptly in Europe, and was the most successful device in smoke prevention.

J. H. Setchel: It seems to me that the remedy for black smoke is a good deal like the remedy for many of the ills that human flesh is heir to, and the remedies that are always prescribed by the doctors. When we have to cure the black smoke evil we refer directly to the engineer and fireman. I think that is fully as important a factor in the matter as is the doctor when he prescribes rest, and it emphasizes more clearly than anything has, what my friend Gaines and two or three other speakers have referred to, the necessity of a mechanical stoker. Regularity in the operation of the locomotive ensures the absence of smoke almost absolutely. As soon as the engineer and fireman cease to be interested in preventing smoke then we are sure to have smoke. It seems to me that the only remedy is a mechanical stoker, and then I am not sure but we will need a mechanical man to attend the stoker. That will be the only way to prevent smoke. I notice what has been referred to by one of the speakers, that some eastern road has suddenly discovered that there is a remedy for black smoke, and that is engineers and firemen, and that they propose to give special attention

to it hereafter, and are going to organize a bureau. If they will only continue to do that I think they will be all right.

Theo. H. Curtis (L. & N.): I do not want to discourage anybody about the mechanical stoker preventing smoke, but I believe that the mechanical stoker for stationary service is to a reasonable degree a protection, and a great many of them do not throw much smoke. But if you do to those mechanical stokers what you do to the locomotive, it will throw smoke, and that is what is called overcrowding it. I think a great many mechanical men in this room have often prepared an engineer and fireman to take the board of directors over the road and did not have any smoke that day. The reason was that the engineer and fireman were very likely selected, or on their mettle, that day. Also the engine was of very light duty capacity. But had that board of directors' train been coupled up to 14 or 15 sleepers you would have seen smoke on the front end of the train. I do not know of any way in which we can do so much work in a small fire box within the limitations that we get upon an ordinary gauge railroad and with the high capacity locomotive, without having smoke at the smokestack when we are doing all we can in the production of power in proportion to the size of the plant.

FRICTION DRAFT GEARS FROM A PRACTICAL POINT OF VIEW.

To the Editors:

"The proof of the pudding is in the eating thereof," is an old and well accepted adage. It distinctly and pertinently refers to the practical demonstration of a problem and brings us directly to the question: Does the friction draft gear protect cars from the excessive shocks of the present severe service? There is an addition to the old adage quoted above, which would seem to apply to an element of the situation, to the effect, that "the proof of the pudding is in the chewing of the pudding bag string." The numerous chewings of the string by our mechanical engineers, who have been giving us technical essays on friction draft gear, and reducing travel velocities, etc., to algebraic equations, are all interesting and valuable. They have undoubtedly shown that the principles of friction gears are correct. Still, there have been a few railroad officials who have had faith enough in the friction gear, as now furnished, to put them in service and get a practical answer to the question being debated by the mechanical engineers. Fortunately the practical results of the application of friction gears is open to any one who will look into the condition of cars which have been equipped with them for several years and notice how well the shocks of service are being absorbed.

A mechanical railroad man, a man of the old school, said that when any new scheme or device was presented to him, he had only one way of looking at it. "Will it bring the answer. I don't know enough about the scientific side to tell anything from curves and diagrams. All I want is to find out if it works, and if it looks good, I try it."

The friction gears have been tried. Are they bringing the answer? There has been as large an amount of hard work, valuable time and good hard money spent on developing the friction draft gear as upon any device brought before the railroad world, and they are no guess work devices that the draft gear companies are offering, though this would almost seem to be the case from some of the "test" reports we see from the railroads themselves. Every gear on the market has been tested by the selling companies to a greater degree than any railroad, as a rule, will ever take the time or trouble for, and all that is really necessary for a railroad officer to do who doubts the "story" is carefully to examine some of the thousands of cars now equipped with friction gear. From an examination of a large number of such cars, the writer has yet to see a car in ordinary service with the end still more than very slightly dented, and that rarely—in many cases it looked as though the coupler horn had never touched the end sill at all. The cars examined were largely of 100,000 pounds capacity, used in hauling coal and ore. It is certainly to be expected that these heavily loaded cars would have shown badly battered end sills if the friction gear had not been bringing the answer.

Mr. Sanderson well says in his paper before the New York Railroad Club that "to be successful in heavy service, the draft shock cushion must be able not only to ease off the blow, but ease off the recoil action also, and the efficiency with which the gear can do this is most important." A person riding on a freight train which has all the cars equipped with friction gear, finds nearly as smooth a movement as in a passenger train, at least this is the report of those who have had the opportunity of riding on some of the test trains, shocks or jerks being hardly noticeable. Such being the facts of the case, it will appear from every point of view that cars of high capacity, either all steel or with steel center sills should have a friction draft gear.

There is no problem in railroading so thoroughly and so satisfactorily answered as the one, "Is the friction draft gear bringing the answer?" Even a cursory examination of the cars equipped with friction draft gears is convincing and will prove to anyone that something is absorbing the shocks, and that something is the answer to the problem,—the friction draft gear.

M. C. B.

Atlantic City, N. J., June 17, 1908.

ITALIAN STATE RAILROADS.*

After more than two years of a system of government ownership where the state endeavored to manage the railroads of Italy through a general official named by the minister of public labor, the government now proposes to place the direction of the lines in the hands of a special commission. The plan which awaits the approval of the next parliament contemplates the appointment of eight members, three of whom are to be government officers of high rank. The director-general, the present head of the administration under the ministry, will sit with the commission as a ninth member, but without the right to vote. All members, as well as the director-general, will be chosen by the minister of public labor, who will also name the presiding officer. Members will serve for six years and will not be eligible for reappointment. A compensation is to be fixed "in full proportion to the dignity and importance of their station and duties," and they are to rank in official registers as councilors of state. They will have supervision of the railroad manager, but the direct supervision of the actual operation of the lines will remain in the hands of the director-general, thus giving him a strong measure of control of the personnel. The lines, while under the direction of the commission, will be under the direct supervision of the minister of labor.

The state railways of Italy comprise about 7,300 miles, of which 2,600 miles have been added since 1885. The lines are roughly divided as follows: (1) Mediterranean line, (2) Adriatic line, (3) Sicilian lines, (4) Southern line, which, though owned by the government, is still operated by a private company, but is in effect a part and continuation of the Adriatic line.

It is estimated that the state has expended since 1860 $893,600,000 for lines and rolling stock for its roads and that for the same purposes owners of local branch and privately managed lines have spent $231,000,000. Credits issued by the government on account of railroad expenditures amount to date to $260,000,000, thus making the total cost of the Italian roads up to 1906 $1,384,000,000, about four-fifths of which has been borne by the state. The state railways and their equipment and maintenance have, therefore, cost nearly $158,000 per mile. The expenditures met by the state have been sustained by taxation and by the issue of government railroad bonds bearing 5 and 4½ per cent. interest and by notes bearing 3 per cent. interest and redeemable in 30, 50 and 90 years.

In November, 1906, the government put into effect a schedule of passenger rates which materially lowered the fares throughout the country, particularly for the longer distances. Second-class fares in general are two cents per mile, with reductions of from 10 to 25 per cent. on round-trip tickets. First-class fares, representing what in the United States would be ordinary trains, are, as a rule, about 5 per cent. more than second-class; and third-class about 5 per cent. less than second-class. Second-class accommodations on the express trains are practically the same as first-class, but the distinction is maintained for the benefit of foreign travelers.

*From United States Consular Report.

With Exhibitors and Others

The Consolidated Railway Electric Lighting & Equipment Company, New York, in booth 435, demonstrated the superiority of its axle-driven generators for car lighting. The system is claimed to be absolutely automatic, providing a perfect regulation, giving a constant lamp voltage. The output of the dynamo is regulated automatically, the current being cut down according to the battery needs.

* * *

Worth Brothers Company has never made an exhibit at the conventions, but next year its representatives will be on hand to show some of its products. This concern makes a specialty of charcoal iron tubes for locomotives, claiming to be the only one in the country doing this. Also it claims to roll the largest boiler plates in the country. Charley Shults says the latch string will always be hanging in full view, and its "Worth" it to take a look.

* * *

The Detroit Leather Specialty Company, Detroit, Mich., makes the "Wear Well" leather packings of the best grade of leather to any specifications. This packing is well adapted for hydraulic and compressed air machinery.

* * *

The "Cyclone" high-speed chain hoist, manufactured by the Chisholm & Moore Manufacturing Company, Cleveland, Ohio, are built for power, speed and durability. The self-lubricating graphite-bronze bushings require no oil and will run indefinitely without cutting. In overhauling only 39½ feet of hand chain, these hoists are said to raise a load of two tons to a height of one foot with a pull of 125 pounds.

* * *

The exhibit of the Chicago Railway Equipment Company was thought last year to be as attractive as possible, but the exhibit this year was found even more admirably arranged than last year. The generous use of space, the tasteful combination of tan and deep brown colors with the green and white of the booth, the inviting green wicker chairs, flags and ferns and flowers all made up a beautiful display. The well known Creco, Diamond, National Hollow, Reliance, "96," Monarch and Sterlingworth beams were displayed on racks at the ends of the exhibit and there were several brakeheads shown in connection with these beams. The Monitor bolsters displayed covered the various types for 30, 40 and 50-ton capacity cars. Two of these bolsters had the channels very cleverly compressed by allowing the metal in the webs to pack. A separate channel displayed workmanship and skill with which this compressing is done. The Creco slack adjusters received much attention, as well as the Creco box and lid and Creco brake jaw.

* * *

The inventors and manufacturers of the Excel car coupler desire to extend to the members of the M. C. B. and M. M. associations their sincere thanks for the many favorable comments concerning their coupler. This is applicable to freight, passenger and locomotive equipment, and consists of three parts—the bar, the knuckle and the lock, doing away with the pivot pin, chains and clevises. Under the M. C. B. tests it is claimed the Excel proved superior to couplers having the pivot pin, owing to the failure of this member. The Excel is made by the Scullin-Gallagher Iron & Steel Co., St. Louis, Mo.

* * *

Both heads of the Gisholt boring mill exhibited in space 138-142 are operated by power through a rapid traversing device. To illustrate the usefulness of this device, suppose a cut has been completed. By merely throwing a lever the operator immediately may move the head rapidly in any direction to the place at which he wishes to begin the next cut. This mechanism is entirely independent of the feed works, either with the table in motion or at rest. Thus the head may be allowed to travel rapidly till stopped by one of the automatic trippers, or it may be stopped immediately at any point by merely bringing the controller back to a central position. This mechanism also operates at either limit of traverse whether previously set or not.

* * *

The Ostermann Manufacturing Company, West Pullman, Chicago, has a plant which is equipped with modern up-to-date machinery, operated on a piece-work basis, where they are in position to repair and rebuild freight equipment at a cost said to be 40 per cent cheaper than railroad shop figures.

* * *

The Lancaster Knife & Machine Works, Lancaster, N. Y., in space 147, showed the Lodge & Shipley lathe, equipped with Derrer's patent device for turning and boring odd shapes. The twisting off of drill tangs or mutilation of the shank surface is entirely eliminated by these shapes, made in ovals, triangles, squares and odd shapes. The Lancaster drill ejector, made for oval shank drills, shows a very efficient method of removing drills without injury to them. The Derrer patent attachment provides for gears giving shaft ratios to spindle of 1 to 1 for eccentrics, 2 to 1 for ovals, 3 to 1 for cams and 4 to 1 for squares.

* * *

J. Gibson McIlvain & Co., Philadelphia, Pa., at their booth 474, have been distributing copies of the anniversary number of McIlvain's Lumber News, which contains some interesting items in connection with the lumber trade.

* * *

Charles R. Day, who was with the Midvale Steel Company for eight years, has recently engaged with the National Aniline & Chemical Company of Philadelphia, which is the selling company for Schoellkopf, Hartford & Hanna Company, of Buffalo, to introduce "Steel-Kote" to the railroad trade. He attended the convention in the interest of the company.

* * *

The Wm. Sellers & Co., Inc., very interesting exhibit of machine-tool and drill grinding machines consisted of three of their late designs. The first one is a 3-inch drill grinding and pointing machine for holding and sharpening drills from ⅛ inch up to 3 inches inclusive, either flat or twist drills. By means of the slicing movement of the emery wheel peculiar to this drill grinder, its surface is kept perfectly true and the cutting edge made a straight line. A centrifugal pump supplies a stream of water on the point of the drill that keeps it cool. This feature is in all these tools. The No. 1 tool-grinding and shaping machine will grind quickly and accurately all kinds and shapes of cutting tools used on lathes and planers, it will take in tool shanks up to 2 x 2½ inches. Accuracy of shape at the cutting edge is an important factor in the amount of work done by any tool, this point has been kept in view in designing these machines. The No. 2 tool grinder is designed to do exactly the same work as the No. 1, but for smaller tools; all the movements are light and easily handled. The injector exhibit consists of a working non-lifting injector with automatic lazy cock attachment showing the cab arrangement of bracket to hold extensions, with strainer and boiler check. The seat and valve of this stop and boiler check can be removed for repair without disconnecting pipes, and with full pressure on boiler. A number of sectional injectors and sectional boiler check valves for side and back head of boiler improved patterns are also shown.

* * *

Handy mailing lists, as furnished by the Railway Equipment & Publication Company to patrons of the Pocket List of Railroad Officials, seem to be all that the name implies. It is easier to put on a stamp than it is to address an envelope and there is in many instances much to be said on the score of legibility. The company has such lists printed

and gummed ready for use, covering all mechanical and purchasing officers of the 1,300 or more railroads named in the list. For the addressing of circulars and similar matter it seems unquestionable that their use must save an amount of clerical time that would go far to decrease the cost of circularization. Some people have found the handy mailing slips extremely "handy" as a short method of making card indexes.

* * *

The Davidson locomotive raiser—a recent acquisition of the U. S. Metal & Manufacturing Company—is a new device in the East, but in the West one prominent road has given it strong recommendation by making it one of the company's standards. The Hillman locked turnbuckle which requires no boards is another device handled by the company; it is claimed to prevent rod riding by tramps.

* * *

Vibration in railroad shops is a large factor in increasing maintenance cost of skylights. The Anti-Pluvius skylight system seeks to reduce this charge by the use of hair-felt as a rest and for binding glass, and a spring auxiliary to take up any unusual expansion or contraction. The entire length of the Lackawanna coach shop is covered at the ridge with skylights of this type, and up to the present no cracks have appeared in the glass. The Anti-Pluvius skylight is manufactured by the G. Drouve Company, Bridgeport, Conn.

* * *

W. H. S. Tenny, the originator of Crysolite, and chemist for many years for the Semet-Solvay Company, is now engaged with Schoellkopf, Hartford & Hanna Company, of Buffalo, N. Y. He has attended this convention to explain the merits of "Steel Kote," a protective coating for steel, which is his most recent discovery.

* * *

Evans, Almirall & Company have been distributing oval mirrors as souvenirs for the ladies and dice boxes containing five dice as souvenirs for the men. The representatives of the company, whose booth is No. 68, are Douglas Sprague, Benjamin Kauffman and C. D. Allen.

* * *

The National Aniline & Chemical Company, of Philadelphia, showed "Steel Kote" a paint for the protection of steel made by Schoellkopf, Hartford & Hanna, of Buffalo, in its booth. It is claimed for this product that it will resist 33 per cent sulphuric acid, nitric acid, muriatic acid, aqua ammonia, common brine solution or caustic soda liquor if properly applied. It is specially recommended for locomotive front ends and stacks which are subject to high temperature.

* * *

A track exhibit which attracted attention and favorable comment by railroad men, and others interested in safety appliances, was a tubular telescopic folding flat car stake, designed and manufactured by the National Tube Company, Pittsburg, Pa. The stake is folded and laid in pocket at rest when not in use, while others are drawn out to half and full length when loading lumber, steel pipe or other long material, now requiring stake pockets and breakable wooden standards. Being made into the frame of the car, it is impossible for these steel tubular stakes to be detached from the car.

* * *

The Gould Coupler Company brought to the convention a full size draft gear for both freight and passenger service. These are claimed to be the simplest with the greatest capacity. 15,000 freight cars have been equipped with them and 3,000 passenger coaches. The passenger draft gear is combined with the friction buffer and passenger steel platform and makes a compact, efficient and accessible arrangement. As usual, the company is showing all the varieties of the Gould coupler, top, bottom and side unlocking devices, and in particular the very latest coupler designed by its engineers. In the Hartman ball-bearing center plate and side bearings the company is now offering the result of five years' development in this line of railroad equipment. These designs may be changed to suit any truck and body construction. The balls are designed to carry 12,000 pounds and tested to 70,000 pounds. The Gould Coupler Company is now producing a cast steel journal box with inset lid. These are the first boxes of that kind to be made. To these are added the Crown bridge girder construction bolster and side frame, in all a most complete display of car and locomotive equipment.

* * *

The hose clamp of the Thompson Manufacturing Company, Newark, Ohio, for use on air brake and feed water hose, has special advantages for such service, it is said, because of its strength, indestructibility, cheapness and ease of application.

* * *

The Commonwealth Steel Company, St. Louis, Mo., had a model of its all steel bumper beam with spring buffing arrangement, which received a large share of attention from the Master Mechanics.

* * *

The exhibit of the Asbestos Protected Metal Company, Canton, Mass., in booth 565, included, besides roofing paints and cements, asbestos protected metal for car use such as roofing, siding and interior sheeting. This material is stated to be rust and fire proof, and not subject to deterioration from sulphurous or other acids. Besides its use in car construction this material is made into flat, corrugated and beaded sheets, all sorts of ridge capping, flashings, etc. The Robertson box car roof is said to be in extensive and successful use on the lines of the Intercolonial Railroad of Canada.

* * *

The exhibit of the General Compressed Air & Vacuum Machinery Company has attracted a great deal of attention which has resulted in a large number of sales of both the railroad car cleaners and residential plants. The vacuum cotton picker also has excited wide interest. R. C. Hallett was in New York on Tuesday and closed the contract for the vacuum cleaning machinery and complete equipment for the New Phoenix Hotel at Buenos Ayres, Argentine. This is believed to be the first complete vacuum equipment of the kind to go to the Argentine Republic.

* * *

The Delaware Lackawanna & Western is extending the use of Mason tread throughout the system, shipments of carborundum tread having been made to them at Scranton, Pa., their Newark, N. J., Station, and to the New York City ferry house.

* * *

The J. G. Brill Company is one of the prominent exhibitors at the conventions this year. The company is exhibiting its No. 27-E 3 truck on the pier. This truck is of a type which has demonstrated the correctness of its design for high speed service on many electric railways as well as on steam lines and is meeting with increasing approval from steam railway officials because of the considerations in its design for elements encountered in high speed service which are not covered by the M. C. B. design. The officials of the company are showing their interest in the development of the field for the truck and other branches of its business and Samuel M. Curwen, vice-president and general manager; J. W. Rawle, assistant general manager; W. H. Heulings, manager of sales department; W. S. Adams, C. P. Brown and S. M. Wilson have been in attendance.

* * *

The proper washing of locomotive boilers appears to have been badly neglected for some years, but the introduction of large fire boxes, brick arches and high pressures, has made the subject of boiler washing one of the most important propositions in connection with the maintenance of boilers. The Master Boiler Makers' Association handled this subject

a few years ago, the Traveling Engineers' Association had this as a committee subject in 1907, and the Master Mechanics' association has a committee report on it at the present convention. Information gathered from these reports indicates that locomotive boilers must be washed and filled with hot water, but that unless the hot water can be obtained from the heat in the water blown out of the boiler, washing with hot water is a very expensive proposition.

* * *

The Commonwealth Steel Company of St. Louis manufactures a non-derailing boltless tender truck made with either swing motion or rigid as desired. It is quite similar to the easy riding equalizer tender truck except that the entire frame is made of one piece, doing away with a large number of parts, and reducing repairs and derailments.

Railway Supply Directory.

On account of its constant use in all railway offices as a book of reference, the publishers of the Pocket List of Railroad officials consider their classified list of manufacturers of railroad material one of the valuable features of the book from a commercial point of view. An examination of the latest issue, of which a generous supply is provided at the convention, shows that the wares of the 491 advertisers are classified in a list requiring 40 pages of small type and under 1180 different heads. It is curious to note that the largest number of firms under any individual head is under "Jacks," with 26 manufacturers represented, though this number would be far exceeded under a number of other heads, notably "Paints," were it not for a close sub-division of heads according to the special purpose to which the article may be especially adapted. Under the head of "Car Builders" 22 concerns are represented and there is the same number under "Machine Tools," though again, in the latter instance, the number is materially reduced by sub-division. The publishers are to be congratulated that their classified list is so thoroughly representative of the entire railroad supply industry and embraces so large a number of the most important houses engaged in the several branches.

BUSH & McCORMICK EXHIBIT.

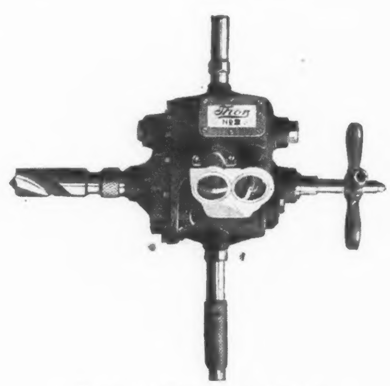
The specialties exhibited at the conventions by Bush & McCormick, of Columbus, Ohio, include a switching brake, an osculating anti-friction center bearing and a friction draft gear. The switching brake is designed for the convenient control of cars through gravity yards; the brake staff is placed transversely in the car under framing with a foot lever at each end of the shaft operating through a pawl and ratchet. The brake is operated by foot power by the car rider as he stands on the step; release is effected by lifting the lever. An ingenious slack adjuster is a part of the mechanism.

The anti-friction center plate is a modification of the conical roller design, the sides of the cone elements being cut away so that a larger number of pieces may be contained in a bearing of given diameter. This increase in the number of bearing elements permits the use of a metal less expensive than hardened steel; the bearings exhibited have cast steel shells with drop forgings for the bearing elements, but it is believed that malleable iron will prove to be satisfactory for this purpose. The dimensions and spacing of the bearing pieces are such that a movement of the upper plate relative to the lower one of about 18 degrees may be had freely, this being sufficient for the curving of the trucks of a 75-foot car on a 35-degree curve. A feature of the design is a spherical bearing for under surface of the lower bearing case, thus permitting the bearing nest to assume at all times positions normal to the load, so that each bearing element is under the same stress. This bearing is the joint work of S. P. Bush, of the Buckeye Steel Castings Company, and E. S. Woods, of Edwin S. Woods & Co.

The friction draft gear shown is the invention of Mr. McCormick. It consists of seven elements, two similar cylindical caps, two pairs of friction pieces each of which is a quarter of a right circular cylinder, beveled at one end, and a helical spring. The four friction pieces are surrounded by the spring which is held in place longitudinally by lugs on the curved surface of the friction pieces near one end. On the interior of each cap are two inclined surfaces forming a V to engage the beveled ends of two of the friction pieces, the pair thus engaged being diametrically opposite each other. When the buffer comes into action the preliminary resistance is that of the spring engaged between the lugs on the central friction pieces, which are acted upon by the caps. Later the V-surfaces of the caps engaging with the beveled ends of the two pairs of friction elements crowd these toward the axis of the gear developing friction between their plane surfaces. The location of the lugs on the friction pieces with relation to the caps governs the extent of the preliminary motion, which in the gear exhibited is ½ inch. This gear has been tested in a stake machine to 300,000 pounds with a total motion of 2½ inches. If lower capacities are desired lighter springs are used.

THOR PISTON AIR DRILLS.

The Independent Pneumatic Tool Company had on exhibition a complete line of Thor piston air drills from the smallest size for very light drilling up to the largest size adapted to extra heavy work. These drills are of the 4-cylinder reciprocating piston type, the cylinders being arranged in pairs for a 2-way crank throw. They have the Corliss valve motion, allowing the live air to be stored and controlled up to within ⅜-inch or less from the cylinder, which, when released quickly, acts on the piston instantaneously. This construction is designed to allow no air to pass except what is used in driving the motor, and effects a very great saving in the consumption of air. All joints in the case have been dispensed with excepting one between gear case and cylinder, thereby simplifying construction, assisting in keeping the working parts in true line and preventing leakage. They are easily accessible and require very little attention and repairs. All drills are fitted with Morse taper standard sockets. The telescopic feed with which they are equipped is one of the good features. The reversible action of the drills is obtained by moving a sliding collar on air handle away from sleeve, and turning the sleeve full over to the right; turning to the left starts the drill forward. The sliding collar is only a safety device, and by moving it toward sleeve drill cannot be reversed, but when moved out of the way the tool is reversed instantly in either direction. Reversible drills are furnished with screw feed or grip handle, as requested by customer. In the Nos. 24 and 25 drills, compound gearing is employed, insuring great power with slow speed without the use of the cumbersome and unsatisfactory reducing motion used with all other makes of air drills to accomplish these results. They are designed for extra heavy drilling, flue rolling, tapping, reaming, setting valves, boring cylinders, and all classes of heavy work. But one set of ball bearings is used, placed between the gear case and spindles. All drills are fitted with removable plates over crank chambers, rendering cranks, toggles, etc., easy of access.



Thor Piston Air Drills.